SECTION 6: ELECTRICAL SYSTEM

CONTENTS OF THIS SECTION

LIST OF ILLUSTRATIONS

1. ELECTRICAL SYSTEM PRECAUTIONS

Observe the following items when working on the system:

1. Always remove rings, watches, etc. before working on the electrical system. Even with the batteries disconnected, capacitive discharge could occur if a component live terminal is earthed through a metal object. This could cause a shock or nasty burn.
2. Do not reverse battery connections. Components such as the alternator or any other having semi-conductor circuity could be irreparably damaged.
3. Never disconnect the battery terminals, or alternator wiring, when the engine is running.
4. The battery leads and alternator(s) wiring must be disconnected before carrying out any electric arc-welding on the car.
5. Wear safety glasses when working near batteries.
6. Do not smoke near batteries.
7. Work on batteries in a well ventilated area.
8. Work on batteries with rubber gloves.
9. When working on battery terminals, isolate your tool with electric tape.

2. GENERAL DESCRIPTION OF THE ELECTRICAL SYSTEM

The electrical system consists of four (4) 12 volt batteries, electrical system monitor, alternator(s), voltage regulator, battery equalizer(s), starter motor and related electrical accessories, components and wiring.

Caution: ***Before carrying out any work on the vehicle electrical system, read through the electrical system precautions.***

3. WIRING AND MISCELLANEOUS ELECTRICAL

3.1 Wiring Diagrams

A master wiring diagram of the electric circuits, covering standard and optional accessories and systems, is annexed in the technical publication box provided with the vehicle. Usually, a separate wiring diagram page is provided for each major function or system. In some cases, more than one circuit may appear on one wiring diagram page; when it occurs, each circuit covered in this page is listed in the wiring diagram index. Moreover, a circuit may appear on several pages; in such case, the number(s) at the extremity of diagram title will indicate the sheet reference number. Refer to the *"Wiring diagram index"* to ensure the correct diagram is being used to trace the circuit in question.

3.1.1 Wiring Diagram Symbols

Various symbols are used on the wiring diagrams to depict different types of electrical components. It is essential to become familiar with these symbols in order to understand the diagrams. The major symbols shown on the diagrams are identified under *"Wiring Diagram symbols"* (page **K** of wiring diagrams).

3.1.2 Using the Wiring Diagrams

Two methods are used to *"work"* with electric wiring diagrams.

1. **You have identified the defective part (breaker, diode, relay, etc.), and you wish to locate its corresponding circuit.**

   Problem: Circuit breaker #83 is released (open circuit) and you don't know which circuit is affected.

   a) Refer to wiring diagram index, and look for *"Circuit breaker code"*, pages **F**.

   b) In the first column, you will find item C.B #83. In the second column, you will find the page number on which to find the corresponding diagram. In the third column the breaker ampere rating, and in the fourth column, the Prévost number. The other columns give you the location and the function of the breaker.

   c) Refer to page 4 keeping in mind the function of the breaker, i.e. "World Transmission VIM Power".

d) When you have located "World Transmission VIM Power", follow wiring until you come across C.B #83 and its circuit.

2. You have a problem with a specific system and you want to find the corresponding diagram.

a) Refer to wiring diagram index and look for specific system.

b) You will find the page number of the components as well as the electric wiring, thus providing you with a complete understanding of this circuit.

3.1.3 Testing Circuits

A careful study of the wiring diagrams should be made to determine the source and flow of current through each circuit. When a circuit is thoroughly understood, a point-to-point check can be made with the aid of the applicable wiring diagrams. Any circuit can be tested for continuity or short circuits with a multimeter or a suitable voltmeter.

All electrical connections must always be kept clean and adequately tight. Loose or corroded connections can result in discharged batteries, difficult starting, dim lights and improper functioning of other electric circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol-type plugs are securely tightened. Knurled nuts on the plastic amphenol-type connectors will click into a detent when properly tightened. Line connectors, which have the side locking tabs, must have the locks latched in place to ensure a proper electrical connection.

3.2 Wires and Connectors

3.2.1 Wire sizes and colors

Each wire in the electrical system has a specific size as designated on the wiring diagram. When replacing a wire, the correct size must be used. Never replace a wire with one of a smaller size.

On vehicle, taking into account that the electric system is provided with different voltages, the insulation on each wire is distinctly colored in order to determine visually the wiring voltage and to assist in making connections. The wires are color coded as follows:

Red	24 volt system
Yellow	12 volt system
Black	grounded wire
Blue	110 V ac system (live)
White	110 V ac system (neutral)
Green	110 V ac system (ground)
Orange	speakers (+)
Brown	speakers (-)
Grey	spare wire

Note: ***In addition, the wires are identified at each 4-6 inch intervals by a printed number.***

Each wire on a diagram is patterned to assist in tracing and testing circuits; the wire number is designed in order to identify at first, the voltage rating, then the wire identification number, and finally the basic wire gauge as illustrated in figure 1.

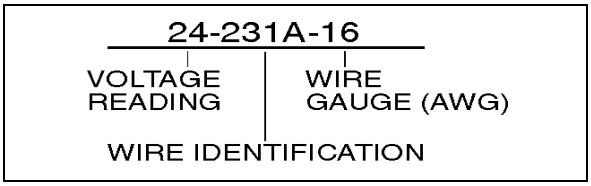


FIGURE 1: WIRE IDENTIFICATION 06048

3.2.2 Spare Wires

When vehicle leaves factory, and even in the case of a full-equipped vehicle, an important number of unconnected spare wires are routed between the junction boxes. Consequently, for any connection of an additional accessory, refer to page D *"Spare wires"* in master wiring diagram to determine the number, the gauge and location of these wires.

Note: ***In addition to the number, the letters "SP" are printed on each spare wire.***

3.2.3 Cleaning Connectors with a Freon-Based Solvent

When the pins and sockets of connectors become dirty, clean them with a good quality solvent containing HFC 134A refrigerant as its active ingredient. HFC 134A has two qualities that recommend it. First, it does not conduct electricity and therefore, will not cause shorting between connector pins and sockets. Second, it evaporates quickly, eliminating the possibility of condensation within the connectors.

Always shake out or gently blow out any excess HFC 134A before assembling a connector to its mating connector or hardware. HFC 134A trapped in the connector can affect the connector seal.

Warning: ***HFC 134A based compounds should always be used in a naturally well-ventilated area, never in a confined space.***

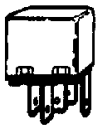
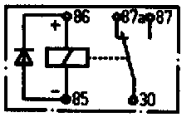
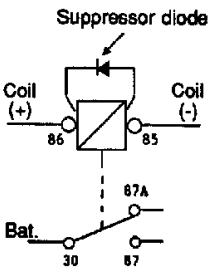
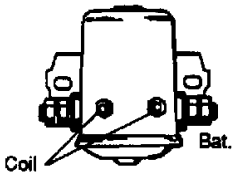
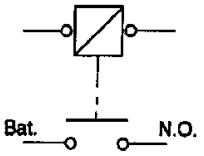
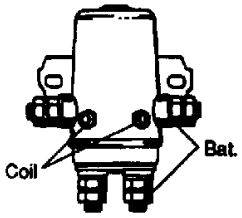
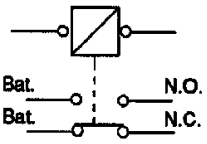
3.3 Relays

Relays are used to automatically energize or deenergize a circuit from a remote location. The relay draws a very low current to energize its coil. Once the coil is energized, it develops a magnetic field which pulls a switch arm closed or open, to either energize or deenergize a given component. As the control current required for the coil is very low, the relay allows a remote station to control a high energy circuit without running great lengths of costly high capacity cable, and also eliminates the need for high amperage switches and heavy connectors.

Many systems on this vehicle are provided with control relays, which are all located in or on the junction boxes (Fig. 2).

Note: ***Each relay is identified with a 12 V or 24 V printed on its casing in order to identify the coil operating voltage.***

Caution: ***The magnetic relays for the starting motor, evaporator and both condenser motors and condenser speed controls should have the 5/16" stud nuts torqued to 4.1 ± 0.4 lbf•ft (5,5 ± 0,5 N•m).***

		Configuration on base	Key printed on casing	Key used on wiring diagram	Example
Cubic relay (Steel or plastic casing) Type: S.P.D.T.					R #5
Magnetic relay (Round steel casing) Type: S.P.S.T.		None	None		R #4
Magnetic relay (Round steel casing) Type: D.P.D.T.		None	None		R #40

NOTE: This relay is provided with an internal suppressor diode; never reverse wiring terminals #85 and 86 at base as a direct short circuit will result.

The relay coils connected to the alternator "relay terminal" should never be provided with a suppressor diode as the output current at this terminal is not rectified, thus rendering relay inoperative.

LEGEND

Bat.	Battery
N.O.	Normally Open
N.C.	Normally Closed
S.P.D.T.	Single Pole Double Throw
S.P.S.T.	Single Pole Single Throw
D.P.D.T.	Double Pole Double Throw

FIGURE 2: TYPES OF RELAYS 06050

4. ELECTRICAL COMPARTMENTS

4.1 XL-40 Coach

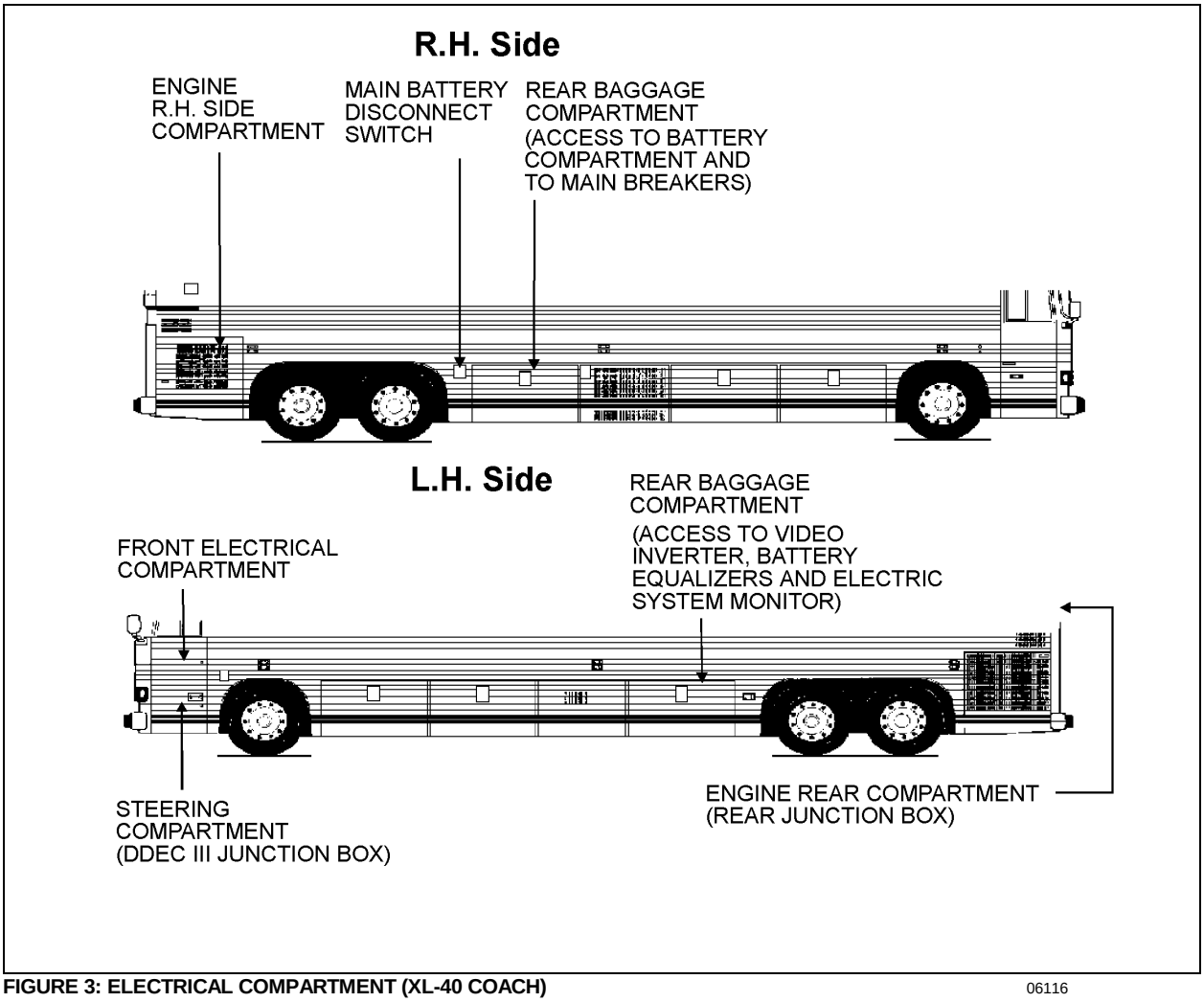


FIGURE 3: ELECTRICAL COMPARTMENT (XL-40 COACH) 06116

4.1.1 Maintenance

To protect components from corrosion, a Cortec VCI-238 corrosion inhibitor has been sprayed in the following electrical compartments and components:

- front electrical compartment;
- DDEC III junction box (steering compartment);
- battery compartment;
- rear junction box (engine rear compartment).

The life expectancy of this product is five years, so it is recommended to spray it back every five years. It is also recommended to spray it on new components when added or replaced.

Warning: ***Use in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.***

4.1.2 Engine R.H. Side Compartment

On XL-40 coach, booster block is located in the engine R.H. side compartment and is accessible through engine R.H. side door (Fig. 4).

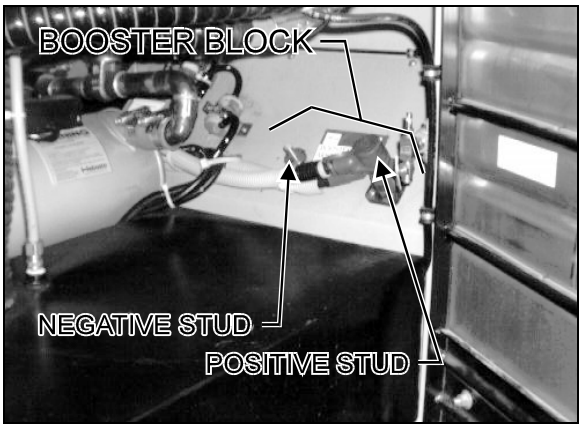


FIGURE 4: ENGINE R.H. SIDE COMPARTMENT 06098

4.1.3 Main Battery Disconnect Switch

This switch disconnect both the 12 and 24 volts. This manual switch is located next to the R.H. Side rear baggage compartment door (Fig. 5).

Caution: ***When vehicle is parked overnight or for an extended period of time, main battery disconnect switch (Fig. 5) should be set to the "OFF" position in order to avoid battery voltage imbalance.***

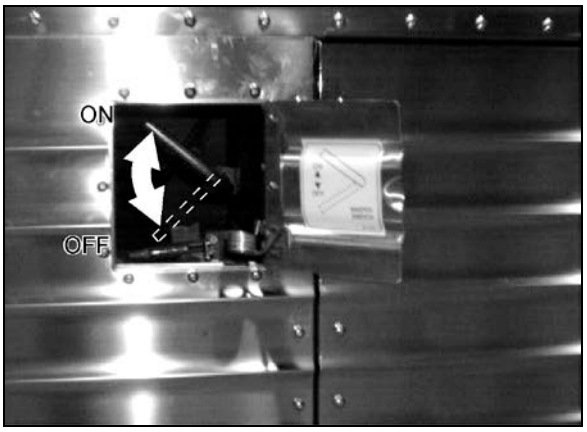


FIGURE 5: MAIN BATTERY DISCONNECT SWITCH 06047

Note: ***When battery disconnect switch is set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers and the Digital Clock.***

4.1.4 Battery Compartment

To gain access to the battery compartment, open the R.H. side rear baggage compartment. Batteries are accessible by means of an access door which is located on the back wall of the rear baggage compartment. To open battery access door, simply take out handle from it's cavity, turn ¼ counterclockwise and pull on the handle.

This compartment contains the following components (Fig. 6):

- the four batteries;
- breakers;
- voltage regulator;
- relays;
- ground stud; and
- 24 volts cut-out switch.

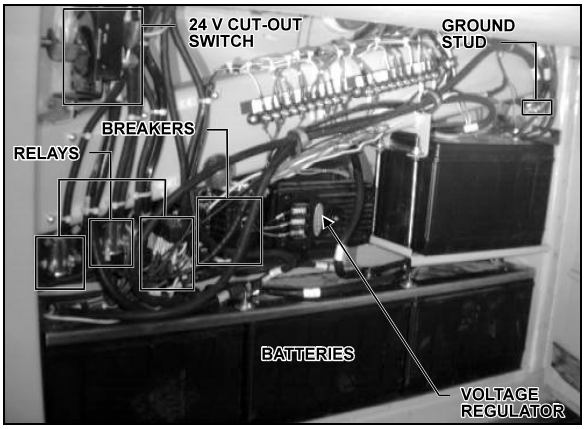


FIGURE 6: BATTERY COMPARTMENT 06117

4.1.5 R.H. Side Rear Baggage Compartment

Electric Circuit Protection

Two type of cutoff mechanisms are installed to protect the vehicle's electrical system; fuses and manually-resetable circuit breakers. If an electrical device is inoperative, check the corresponding cutoff mechanism.

Caution: ***Never replace a fuse with a higher rated one because it will cause severe damage to the electric system.***

4.1.6 Main Breakers

Most of the manually-resettable circuit breakers are located in the: DDEC III junction box, rear junction box, front electrical compartment and in the battery compartment. An identification decal is affixed on the inside face of each door.

XL-40 coach is equipped with six (6) main breakers; they are installed just below R.H. side rear baggage compartment's ceiling and can be identified as follows (Fig. 7):

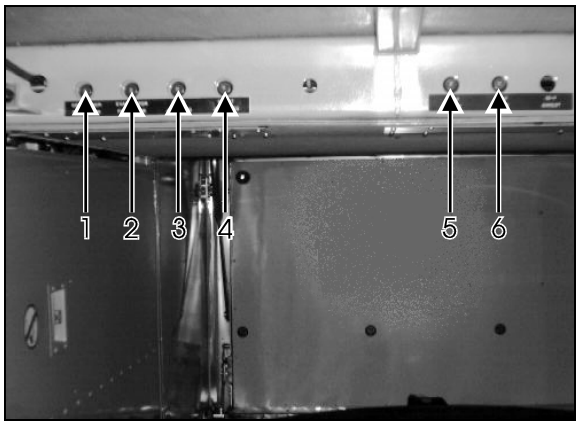


FIGURE 7: R.H. SIDE REAR BAGGAGE COMPARTMENT'S CEILING 06099

1. Condenser fan motor (CB8) 105 amps-24 volts;
2. Evaporator fan motor (CB9) 105 amps-24 volts;
3. Rear junction box (CB7) 90 amps-24 volts;
4. Front junction box (CB6) 90 amps-24 volts;
5. Front junction box (CB4) 90 amps-12 volts;
6. Rear junction box (CB3) 70 amps-12 volts.

4.1.7 Front Electrical Compartment

The front electrical compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 8):

- relays;
- breakers;
- diodes.

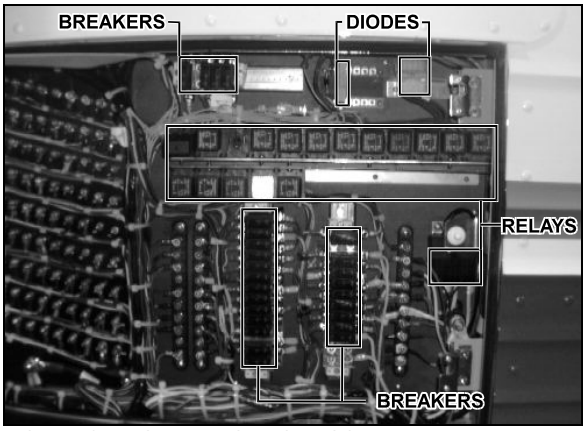


FIGURE 8: FRONT ELECTRICAL COMPARTMENT 06118

4.1.8 Steering Compartment

The front electrical compartment is located on L.H. side of vehicle, under the front electrical compartment. It contains the following components (Fig. 9, 10 and 11):

- ABS blinker switch;
- electronic control unit for ABS;
- electronic control unit vehicle interface module;
- electronic control unit for world transmission;
- DDR connector;
- DDEC III junction box;
- speed limit switch module;
- kneeling module.

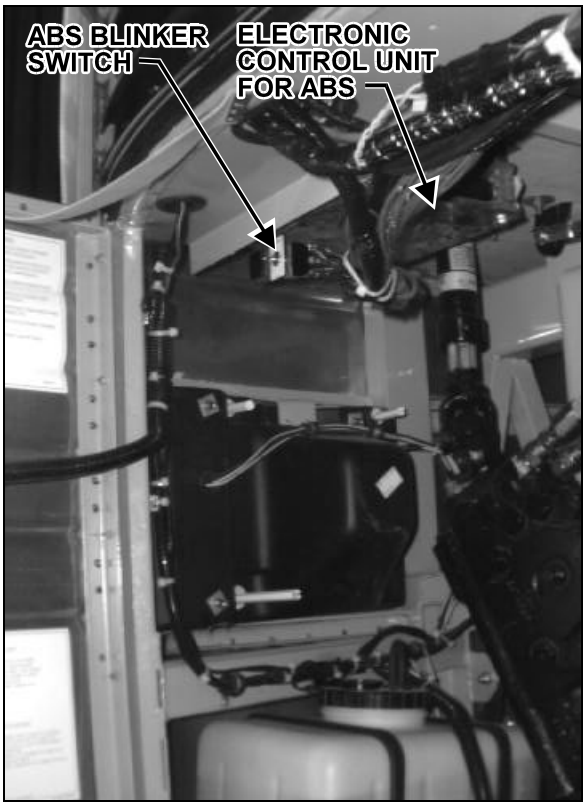


FIGURE 9: STEERING COMPARTMENT (LEFT WALL) 06119

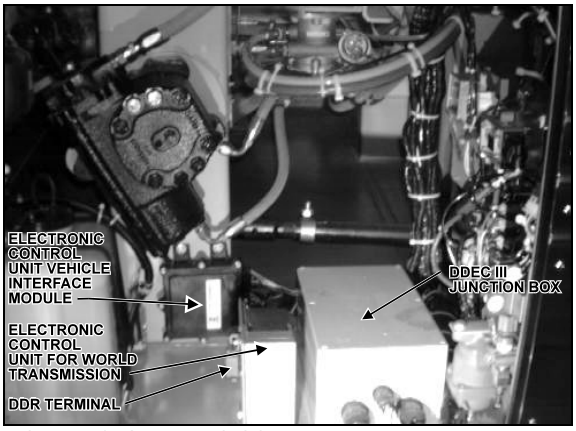


FIGURE 10: STEERING COMPARTMENT **06120**

DDR connector

To enhance troubleshooting and to allow interrogation of the ECU for valuable service information, a DDR (diagnostic data reader) can be used. To use it, plug the appropriate connector (not furnished by the manufacturer) in the terminal located in the steering compartment or the connector located on L.H. control panel. You can also use your push-button shifter to perform certain maintenance operations (see Section 01, Engine, under paragraph "4. DDEC III Diagnostic codes").

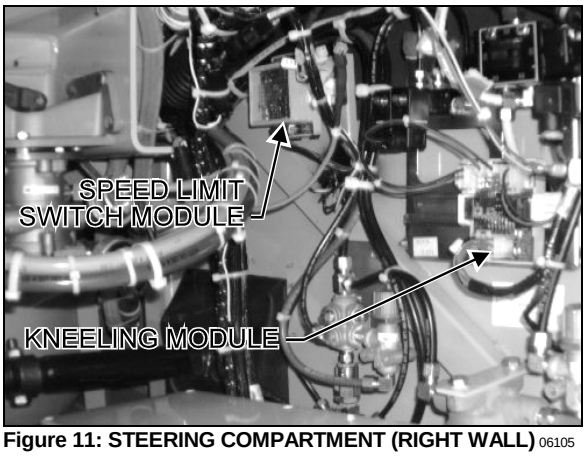


Figure 11: STEERING COMPARTMENT (RIGHT WALL) 06105

Burned fuses (Fig. 11)

Speed limit switch module ..... 3 amps (qty=1)

Kneeling module ..... 3 amps (qty=2)

DDEC III Junction Box

The DDEC III Junction Box is located in the steering compartment, on the floor. It contains the following components (Fig. 12):

- connector;
- relays;
- junction block;
- breakers;
- ABS connectors;
- retarder connectors;
- jacob connectors.

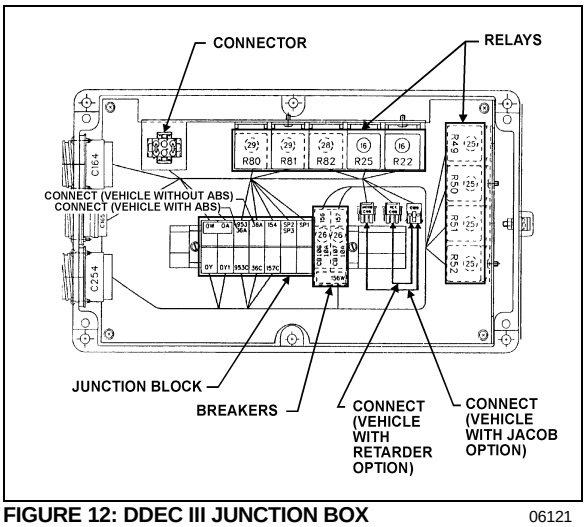
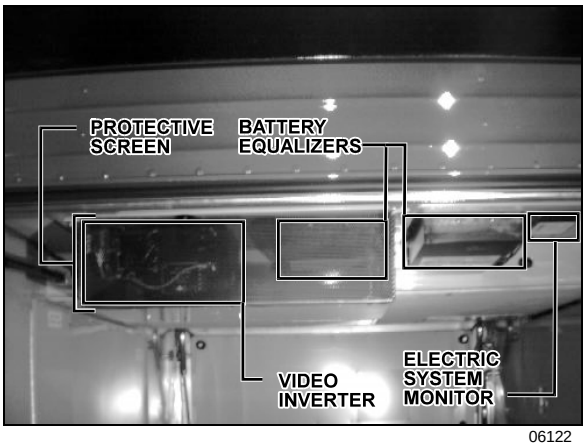


FIGURE 12: DDEC III JUNCTION BOX 06121

4.1.9 L.H. Side Rear Baggage Compartment (Vehicle Equipped With Video System)

This compartment contains the following components (Fig.13):

- protective screen (with video system);
- video inverter (with video system);
- battery equalizers;
- electronic system monitor.



06122

FIGURE 13: L.H. SIDE REAR BAGGAGE COMPARTMENT' S CEILING

Locate burned fuses as follows (Fig. 13):

video inverter 40 amps (qty=2)

To gain access to the fuses, simply remove the inverter's front protective screen.

Battery Equalizers

On XL-40 coach the two (2) battery equalizers ("VANNER"-50 amps-12 & 24 volts) are installed just below L.H. side rear baggage compartment's ceiling. The reset buttons are located on the end of equalizers facing the center of the coach (Fig. 13).

4.1.10 Engine Rear Compartment (Rear Junction Box)

The rear junction box is located in the engine rear compartment.

Switches are located on R.H. side of rear junction box (Fig.14):

- engine compartment light switch;
- starter selector switch;
- rear start (push button switch).

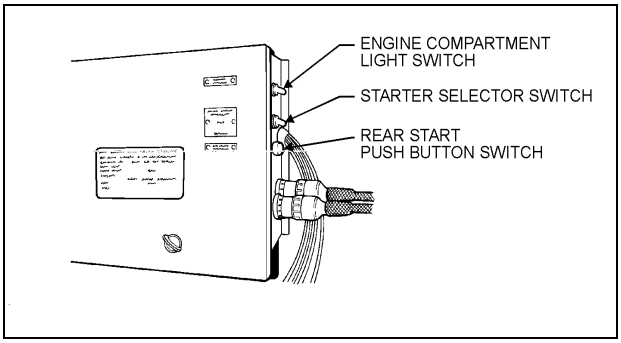


FIGURE 14: REAR JUNCTION BOX SWITCHES 01017

The rear junction box contains the following components (Fig. 15):

- relays;
- breakers;
- diodes;
- time delay relay.

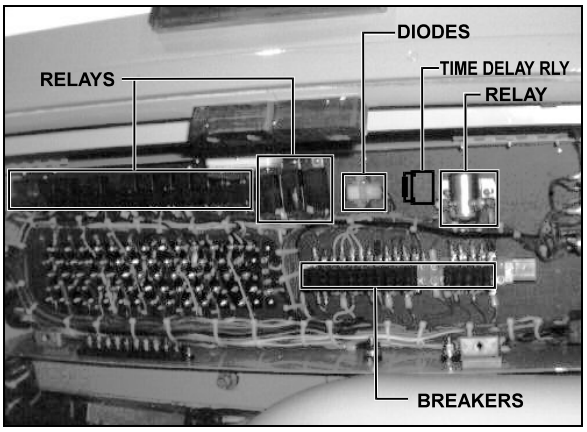


FIGURE 15: REAR JUNCTION BOX 06123

4.2 XL-45 Coach

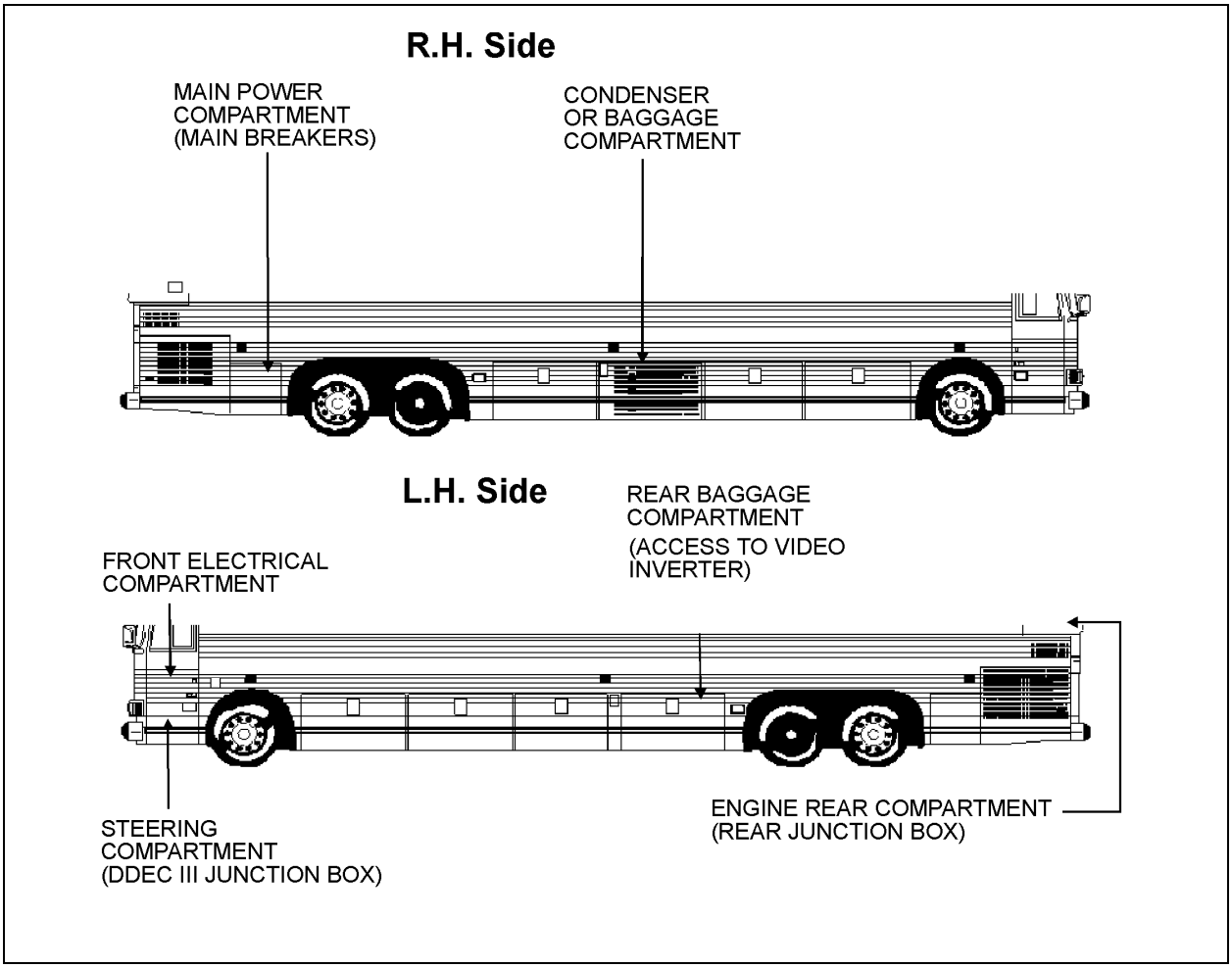


FIGURE 16: ELECTRICAL COMPARTMENT (XL-45 COACH) 06124

4.2.1 Maintenance

To protect components from corrosion, a Cortec VCI-238 corrosion inhibitor has been sprayed in the following electrical compartments and components:

- front electrical compartment;
- DDEC III junction box (steering compartment);
- main power compartment;
- rear junction box (engine rear compartment);
- A/C junction box (condenser compartment).

The life expectancy of this product is five years, so it is recommended to spray it back every five years. It is also recommended to spray it on new components when added or replaced.

Warning: ***Use in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.***

4.2.2 Main Power Compartment

The main power compartment is located on rear R.H. side of vehicle aft the rear wheelhousing. This compartment contains the following components (Fig. 17 and 18):

- the four batteries;
- main circuit breakers;
- voltage regulator;
- battery equalizer (100 amps);
- electric system monitor;
- master relay;
- relays;
- breakers;
- toggle switch;
- booster block (stud).

The toggle switch which disconnects both the 12 and 24 volt systems is located on back wall of main power compartment (Fig.18). Use this switch for maintenance purposes only. The remote battery master switch which also disconnects both 12 and 24 volt systems is located on L.H. lower switch panel (1 , Fig. 19).

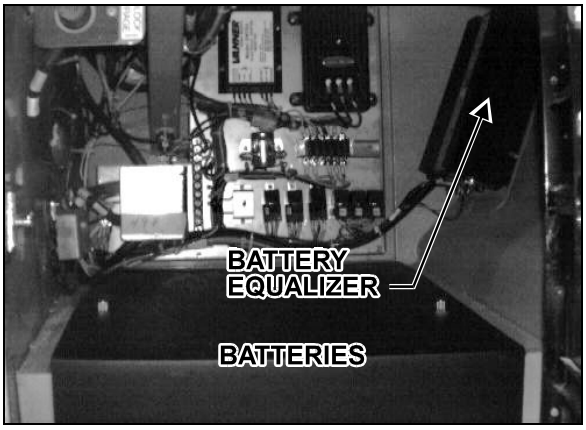


FIGURE 17: MAIN POWER COMPARTMENT 06102

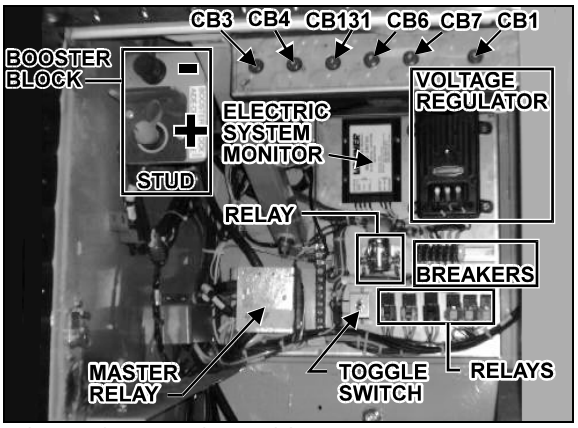


FIGURE 18: MAIN POWER COMPARTMENT 06125

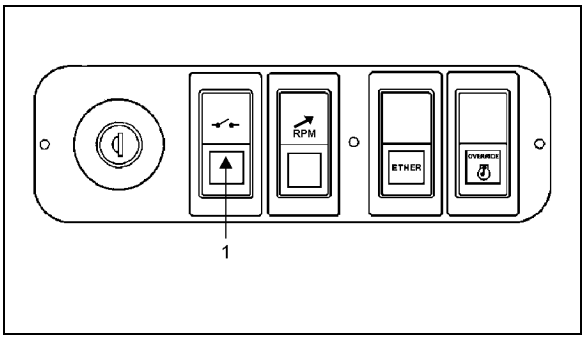


FIGURE 19: L.H. LOWER SWITCH PANEL (BATTERY MASTER SWITCH) 18116

Caution: ***When vehicle is parked overnight or for an extended period of time, battery master switch (1, Fig. 19) should be set to the "OFF" position in order to avoid draining batteries.***

Note: ***When the battery master switch is set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers and the Digital Clock.***

Electric Circuit Protection

Two type of cutoff mechanisms are installed to protect the vehicle's electrical system; fuses and manually-resetable circuit breakers. If an electrical device is inoperative, check the corresponding cutoff mechanism.

Caution: ***Never replace a fuse with a higher rated one because it will cause severe damage to the electric system.***

4.2.3 Main Breakers

Most of the manually-resettable circuit breakers are located in the: DDEC III junction box, rear junction box, front electrical compartment, condenser compartment and in the main power compartment. An identification decal is affixed on the inside face of each door.

XL-45 vehicle is equipped with eleven (11) main breakers; five (5) are installed on A/C junction box located in condenser compartment and the other six (6) are installed in main power compartment and can be identified as follows:

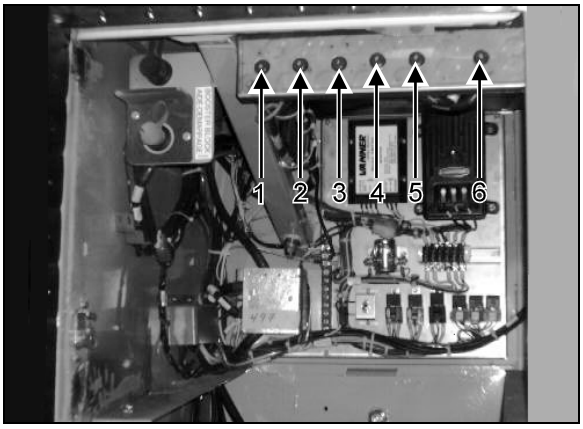


FIGURE 20: MAIN POWER COMPARTMENT 06101

1. CB3: Rear junction box 70 amps-12 volts;
2. CB4: Front junction box 90 amps-12 volts;
3. CB131: Video system (Opt.) 40 amps-12 volts;
4. CB6: Rear junction box 90 amps-24 volts;
5. CB7: Front junction box 90 amps-24 volts;
6. CB1: A/C main 200 amps-24 volts.

4.2.4 Condenser Compartment

The five (5) main breakers installed on A/C junction box (Fig. 21) can be identified as follows:

1. (from left to right)

CB134: Condenser fan motor 15 amps-24 volts;

CB135: Condenser fan motor 15 amps-24 volts;

CB136: Condenser fan motor 15 amps-24 volts;

CB137: Condenser fan motor 15 amps-24 volts;

2. CB9: Evaporator fan motor 105 amps-24 volts.

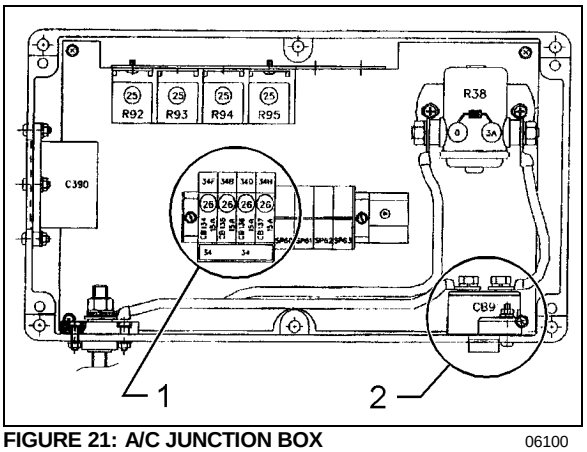


FIGURE 21: A/C JUNCTION BOX 06100

4.2.5 Front Electrical Compartment

The front electrical compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 22):

- relays;
- breakers;
- diodes.

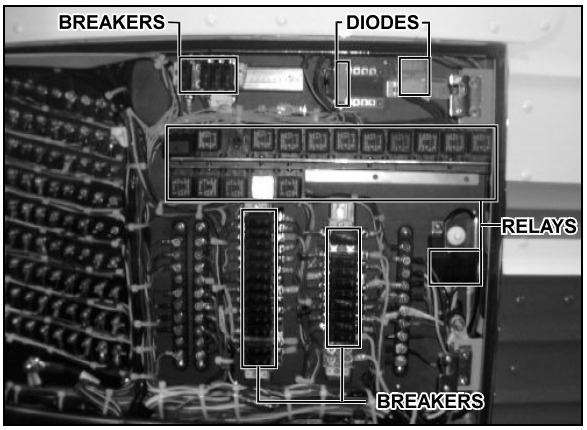


FIGURE 22: FRONT ELECTRICAL COMPARTMENT 06126

4.2.6 Steering Compartment

The front electrical compartment is located on L.H. side of vehicle, under the front electrical compartment. It contains the following components (Fig. 23, 24 and 25):

- ABS blinker switch;
- electronic control unit for ABS;
- electronic control unit vehicle interface module;
- electronic control unit for world transmission;

- DDR connector;
- DDEC III junction box;
- speed limit switch module;
- kneeling module.

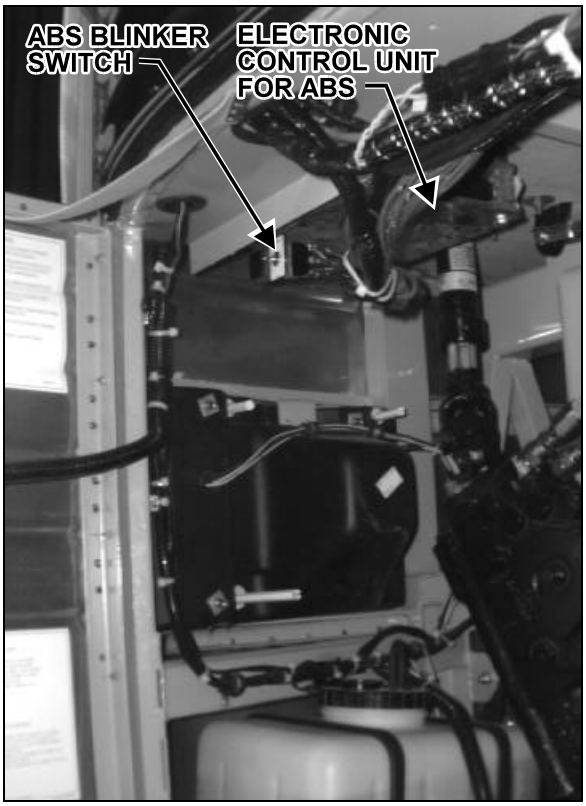


FIGURE 23: STEERING COMPARTMENT (LEFT WALL) 06119

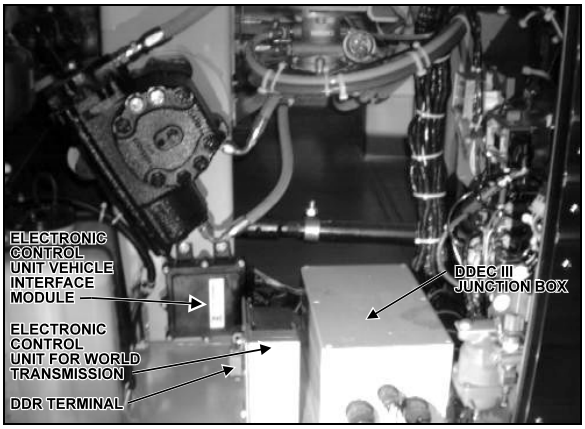


FIGURE 24: STEERING COMPARTMENT 06120

DDR connector

To enhance troubleshooting and to allow interrogation of the ECU for valuable service information, a DDR (diagnostic data reader) can be used. To use it, plug the appropriate connector (not furnished by the manufacturer) in the terminal located in the steering compartment or the connector located on L.H. control panel. You can also use your push-button shifter to perform certain maintenance operations (see Section 01, Engine, under paragraph "4. DDEC III Diagnostic codes").

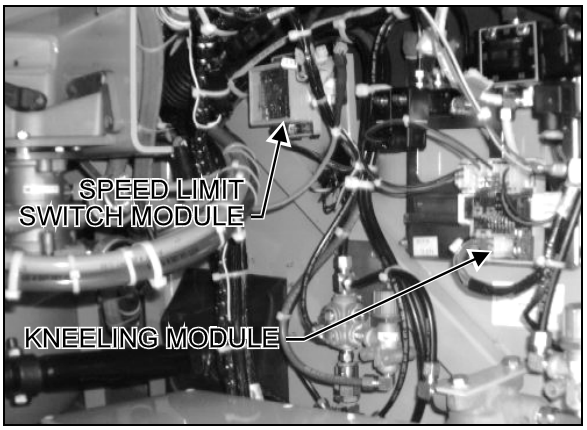


FIGURE 25: STEERING COMPARTMENT (RIGHT WALL) 06105

Burned fuses (Fig. 25)

Speed limit switch module ..... 3 amps (qty=1)
Kneeling module ..... 3 amps (qty=2)

DDEC III Junction Box

The DDEC III Junction Box is located in the steering compartment, on the floor. It contains the following components (Fig. 26):

- connector;
- relays;
- junction block;
- breakers;
- ABS connectors;
- retarder connectors;
- jacob connectors.

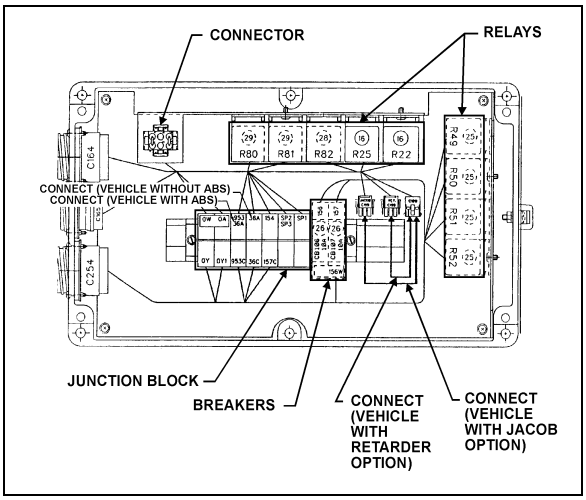


FIGURE 26: DDEC III JUNCTION BOX 06121

4.2.7 L.H. Side Rear Baggage Compartment (Vehicles Equipped With Video System)

This compartment contains the following components (Fig. 27):

- protective screen;
- video inverter.

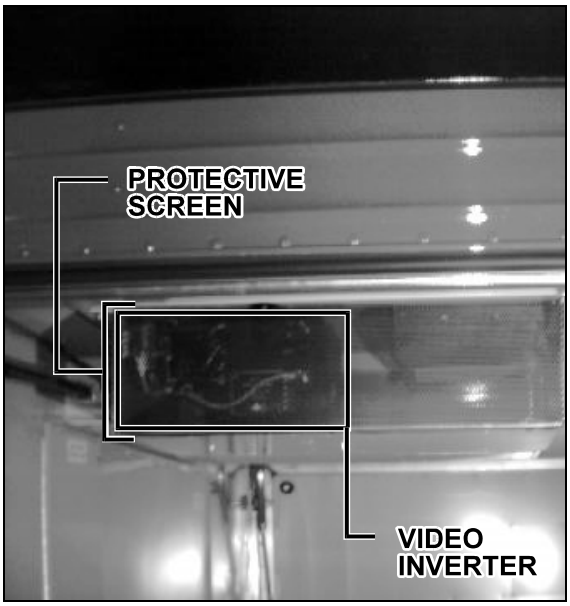


FIGURE 27: L.H. SIDE REAR BAGGAGE COMPARTMENT'S CEILING 06126

Locate burned fuses as follows:

video inverter ..... 2 amps (qty=2)

To gain access to the fuses, simply remove the inverter's front protective screen.

4.2.8 Engine Rear Compartment (Rear Junction Box)

The rear junction box is located in the engine rear compartment.

Switches are located on R.H. side of rear junction box (Fig. 28):

- engine compartment lights switch;
- starter selector switch;
- rear start (push button switch).

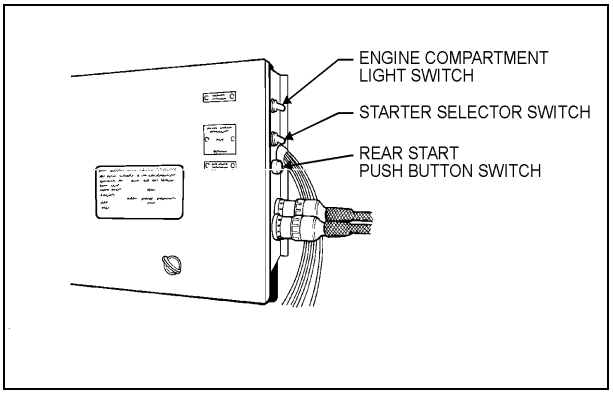


FIGURE 28: REAR JUNCTION BOX SWITCHES 01017

The rear junction box contains the following components (Fig. 29):

- relays;
- breakers;
- diodes;
- time delay relay.

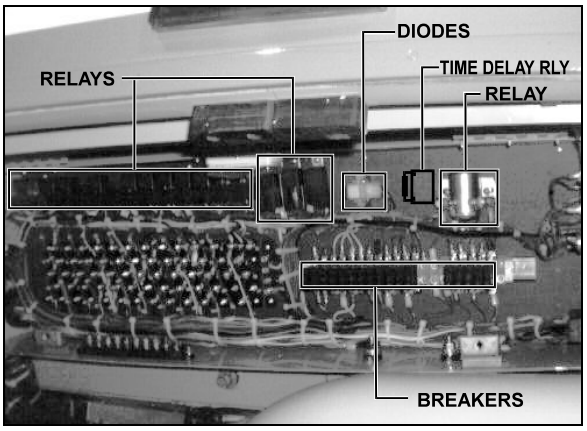


FIGURE 29: ENGINE REAR COMPARTMENT 06123

4.3 XL-40 and XL-45E Converted Vehicles

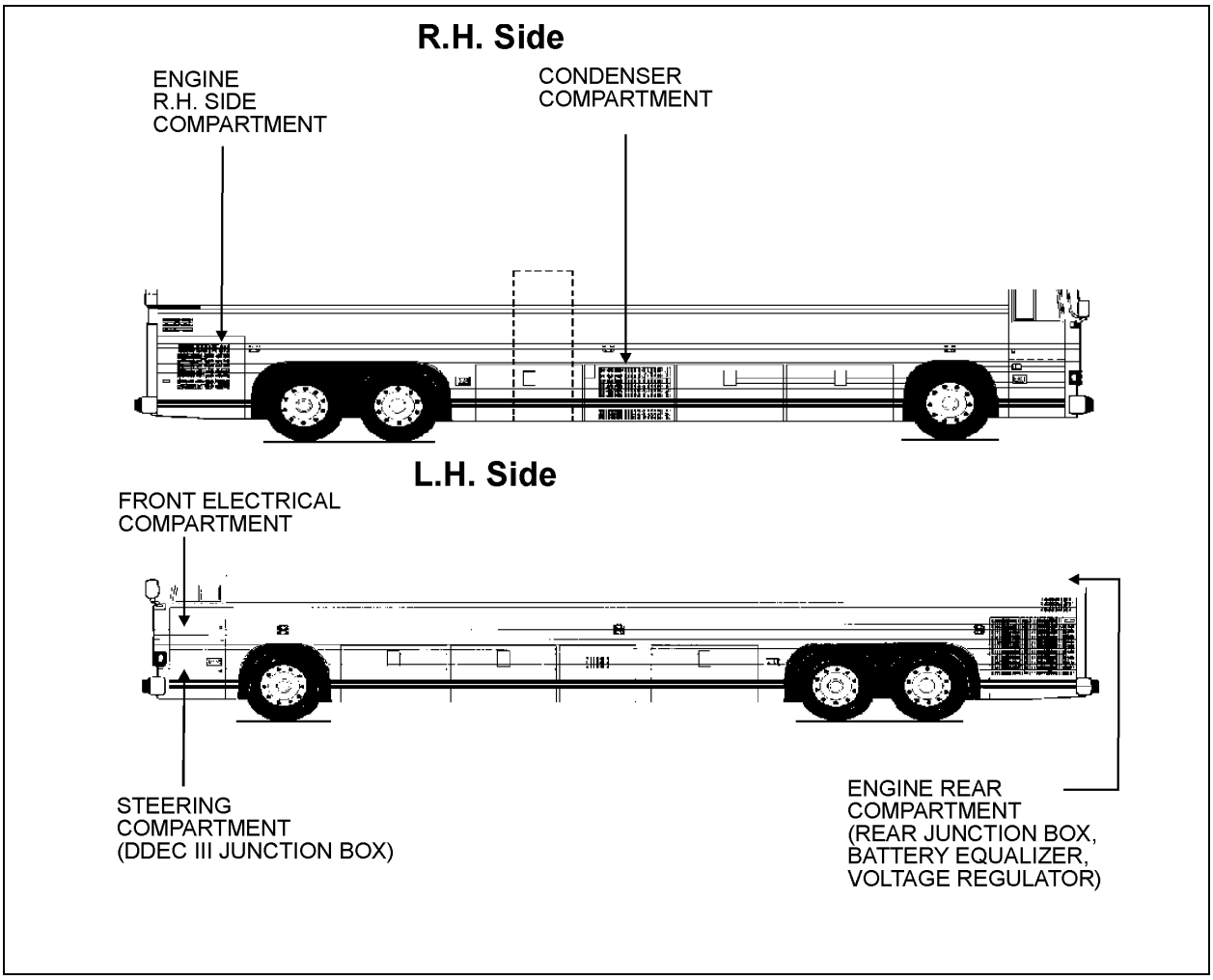


FIGURE 30: ELECTRICAL COMPARTMENT (XL-40 AND XL-45E CONVERTED VEHICLES) 06127

NOTE: ***XL-40 and XL-45E converted vehicles have the same electric system (XL-45E vehicle is extended by its center, it has one extra baggage compartment).***

4.3.1 Maintenance

To protect components from corrosion, a Cortec VCI-238 corrosion inhibitor has been sprayed in the following electrical compartments and components:

- front electrical compartment;
- DDEC III junction box (steering compartment);
- rear junction box (engine junction box);
- evaporator fan junction box (condenser compartment).

The life expectancy of this product is five years, so it is recommended to spray it back every five years. It is also recommended to spray it on new components when added or replaced.

Warning: ***Use in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.***

4.3.2 Engine R.H. Side Compartment

The engine R.H. side compartment is located on rear R.H. side of vehicle aft the rear wheelhousing. This compartment contains the following components (Fig. 31):

- breaker panel;
- 12 volts main battery disconnect switch;
- 24 volts main battery disconnect switch;
- battery equalizer (100 amps);
- electric system monitor;
- batteries;
- volt battery disconnect switch post (+);
- engine ground stud (-);
- battery isolator.

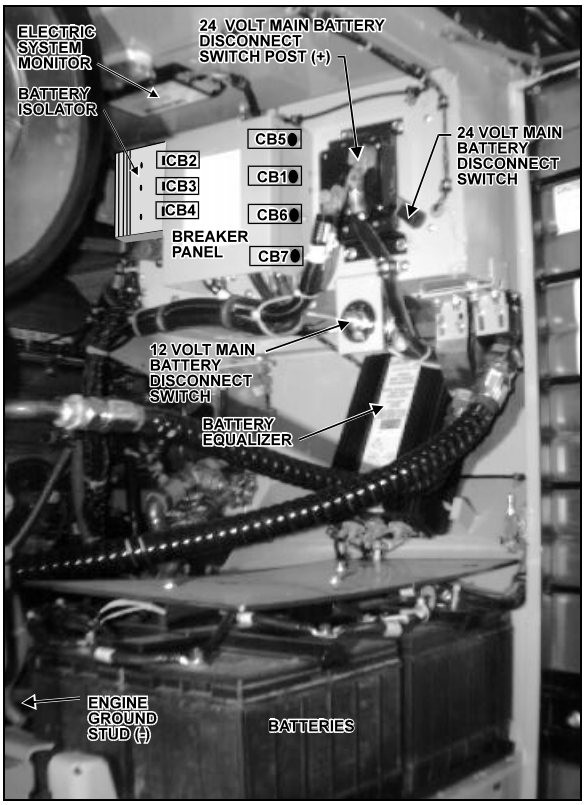


FIGURE 31: ENGINE R.H. SIDE COMPARTMENT 06128

The 24 volts main battery disconnect switch is located above batteries and is accessible by the engine R.H. side access door.

The 12 volts main battery disconnect switch is located directly below the 24 volts main battery disconnect switch.

Caution: ***When vehicle is parked overnight or for an extended period of time, both main battery disconnect switches (24 V & 12 V) should be set to the "OFF" position in order to avoid battery voltage imbalance.***

Note: ***When both main battery disconnect switches are set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers.***

4.3.3 Main Breakers

Nine (9) main breakers may be installed on your vehicle; six (6) of which are standard and three (3) supplied only on vehicles with central A/C system. Breakers CB2 to CB7 are standard and breakers CB1, CB8 & CB9 are optional. breakers are located as follows:

On XL-40 & XL-45E, breakers CB1 to CB7 are installed on breaker panel located in engine R.H. side compartment (Fig. 31). They are accessible through engine R.H. side door and can be identified as follows:

CB1: A/C Full air	200 amps;
CB2: Hot wire rear junction box	30 amps-12 volts;
CB3: Feed rear junction box	70 amps-12 volts;
CB4: Feed front junction box	90 amps-12 volts;
CB5: Hot wire rear junction box	30 amps-24 volts;
CB6: Feed rear junction box	90 amps-24 volts;
CB7: Feed front junction box	90 amps-24 volts.

On all vehicles, optional breakers CB8 & CB9 are installed on evaporator fan junction box located in condenser compartment and can be identified as follows (Fig. 32):

CB8: Condenser fan motor	120 amps;
CB9: Evaporator fan motor	105 amps.

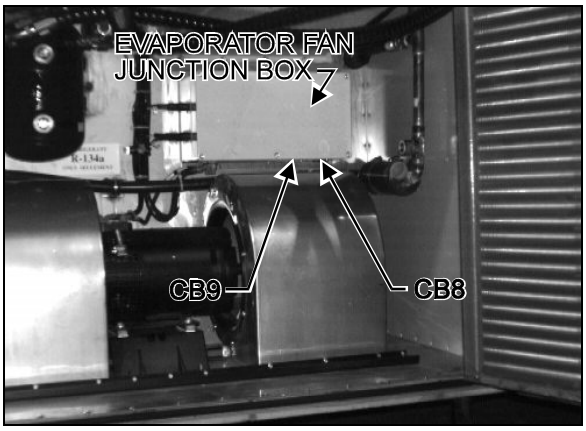


FIGURE 32: CONDENSER COMPARTMENT 06044

4.3.4 Front Electrical Compartment

The front electrical compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 33):

- level-low;
- parking brake alarm;
- relays;
- breakers;
- diodes.

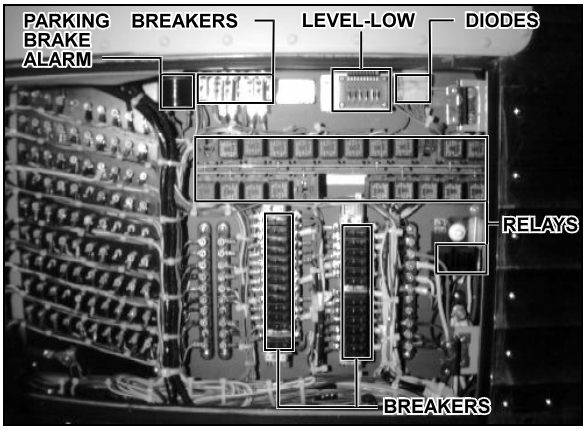


FIGURE 33: FRONT ELECTRICAL COMPARTMENT 06129

4.3.5 Steering Compartment

The steering compartment is located on L.H. side of vehicle, under the front electrical compartment. It contains the following components (Fig. 34, 35 and 36):

- ABS blinker switch;
- electronic control unit for ABS;
- electronic control unit vehicle interface module;
- electronic control unit for world transmission;
- DDR connector;
- DDEC III junction box;
- Speed limit switch module.

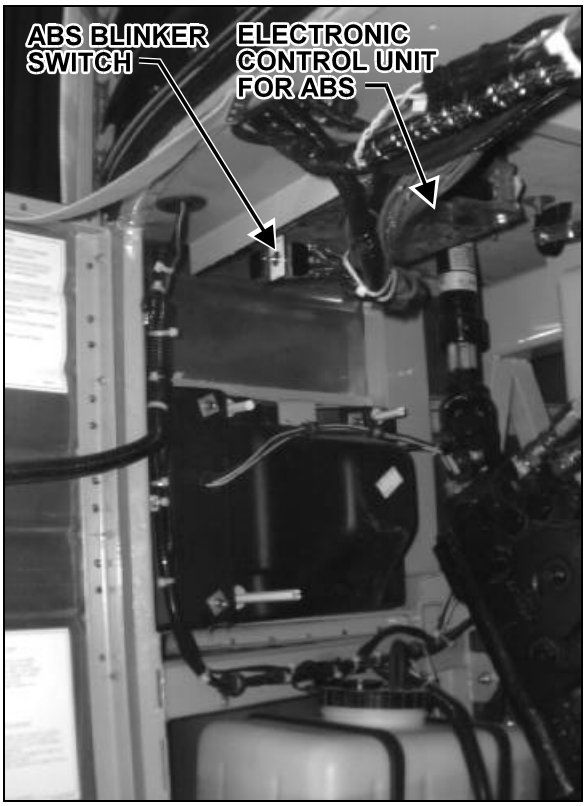


FIGURE 34: STEERING COMPARTMENT (LEFT WALL) 06119

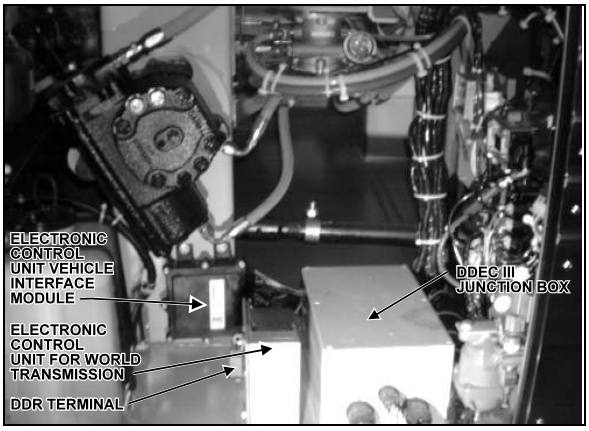


FIGURE 35: STEERING COMPARTMENT 06120

DDR connector

To enhance troubleshooting and to allow interrogation of the ECU for valuable service information, a DDR (diagnostic data reader) can be used. To use it, plug the appropriate connector (not furnished by the manufacturer) in the terminal located in the steering compartment or the connector located on L.H. control panel. You can also use your push-button shifter to perform certain maintenance operations (see Section 01, Engine, under paragraph "4. DDEC III Diagnostic codes").

FIGURE 36: STEERING COMPARTMENT (RIGHT WALL) 06169

Burned fuses (Fig. 36)

Speed limit switch module	3 amps (qty=1)

DDEC III Junction Box

The DDEC III Junction Box is located in the steering compartment, on the floor. It contains the following components (Fig. 37):

- connector;
- relays;
- junction block;
- breakers;
- ABS connectors;
- retarder connectors;
- jacob connectors.

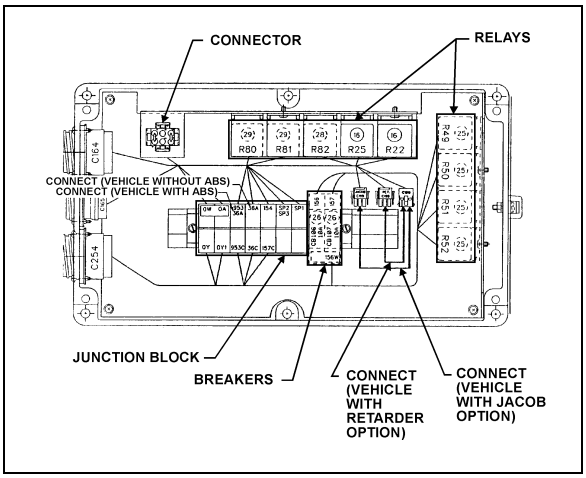


FIGURE 37: DDEC III JUNCTION BOX 06121

4.3.6 Engine Rear Compartment (Rear Junction Box)

The engine rear compartment contains (Fig. 38): rear junction box, voltage regulator and maybe an optional battery equalizer (50 or 100 amps).

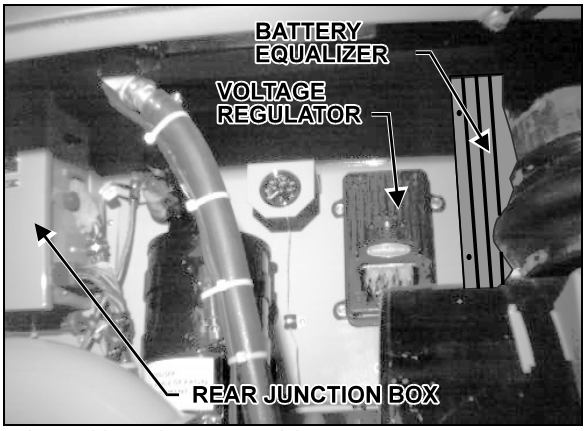


FIGURE 38: ENGINE REAR COMPARTMENT 06130

REAR JUNCTION BOX

Switches are located on R.H. side of rear junction box (Fig. 39):

- engine compartment lights switch;
- starter selector switch;
- rear start (push button switch).

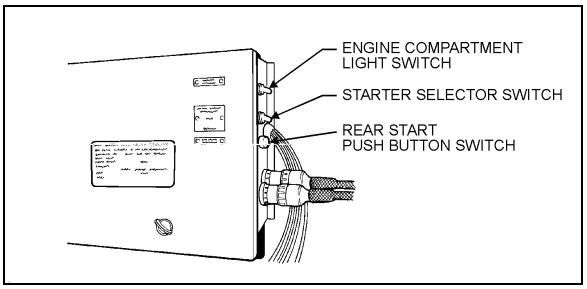


FIGURE 39: REAR JUNCTION BOX SWITCHES 01017

The rear junction box contains the following components (Fig. 40):

- relays;
- breakers;
- diodes;
- time delay relay.

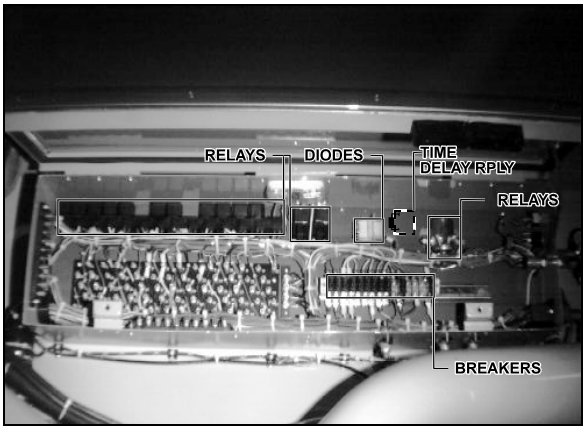


FIGURE 40: REAR JUNCTION BOX 06131

4.4 XL-45 Converted Vehicle

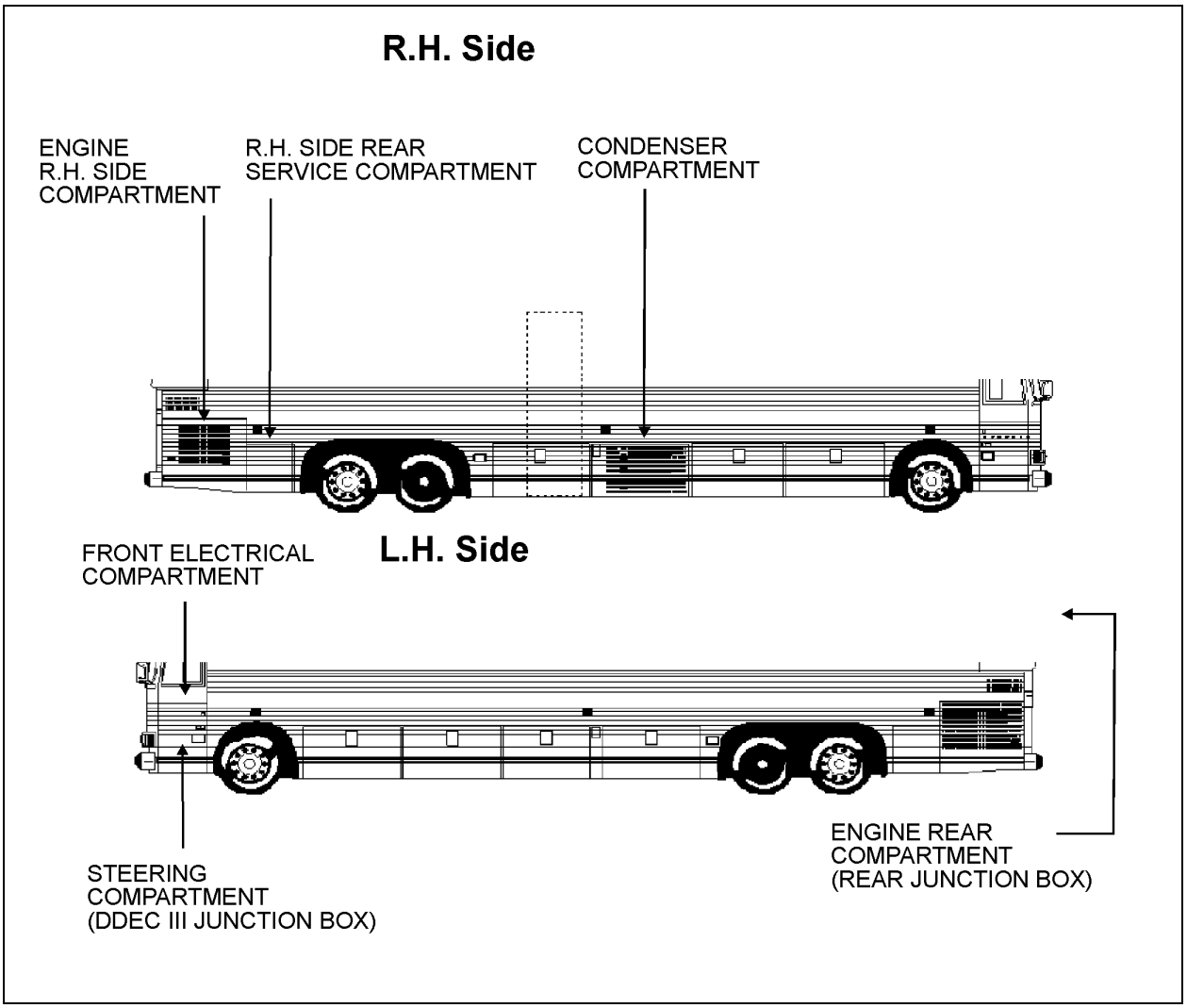


FIGURE 41: ELECTRICAL COMPARTMENT (XL-45 CONVERTED VEHICLE) 06132

4.4.1 Maintenance

To protect components from corrosion, a Cortec VCI-238 corrosion inhibitor has been sprayed in the following electrical compartments and components:

- front electrical compartment;
- DDEC III junction box (steering compartment);
- rear junction box (engine junction box);
- evaporator fan junction box (condenser compartment).

The life expectancy of this product is five years, so it is recommended to spray it back every five years. It is also recommended to spray it on new components when added or replaced.

Warning: ***Use in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.***

4.4.2 Engine R.H. Side Compartment

The engine R.H. side compartment contains the following components (Fig.42 and 43):

- booster block;
- the four batteries;
- main breakers panel;
- voltage regulator;
- battery equalizer;
- battery isolator & relay (optional);
- electric system monitor;
- 12 volts main battery disconnect switch;
- 24 volts main battery disconnect switch.

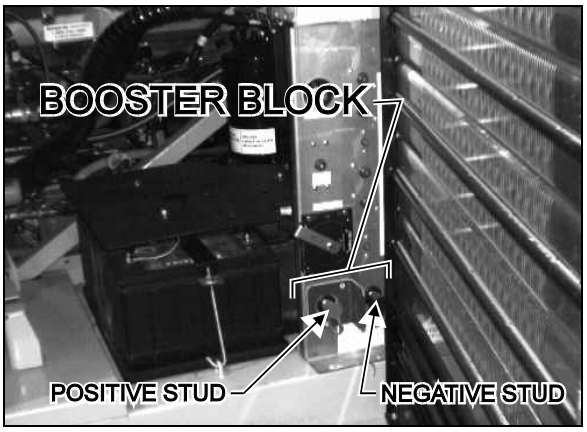


FIGURE 42: BOOSTER BLOCK 06045

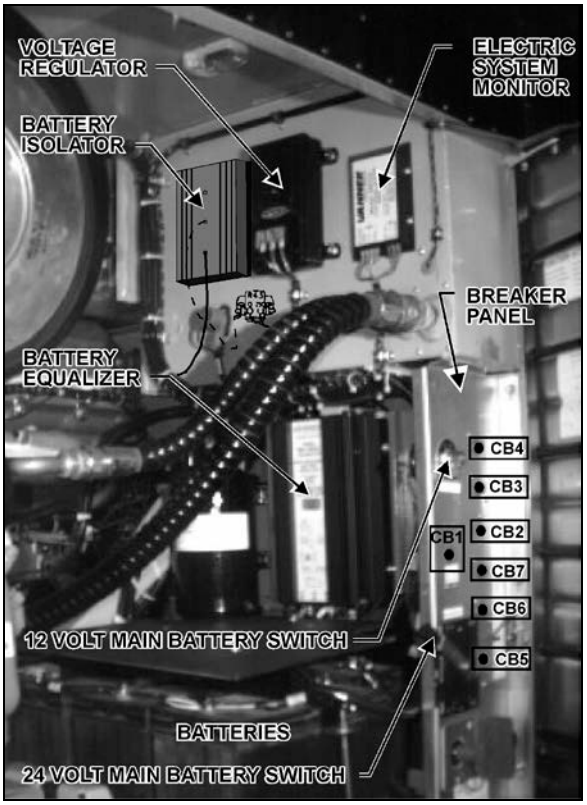


FIGURE 43: ENGINE R.H. SIDE COMPARTMENT 06133

The 24 volts main battery disconnect switch is located on R.H. side of batteries and is accessible by the engine R.H. side access door. The 12 volts main battery switch is located directly above the 24 volt disconnect switch.

Caution: ***When vehicle is parked overnight or for an extended period of time, both battery main disconnect switches (24 V & 12 V) should be set to the "OFF" position in order to avoid battery voltage imbalance.***

Note: ***When both main battery disconnect switches are set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers.***

4.4.3 Main Breakers

Nine (9) main breakers may be installed on your vehicle; six (6) of which are standard and three (3) supplied only on vehicles with central A/C system. Breakers CB2 to CB7 are standard and breakers CB1, CB8 & CB9 are optional. Breakers are located as follows:

On XL-45, breakers CB1 to CB7 are installed on breaker panel and can be identified as follows:

CB1: A/C Full air	200 amps;
CB2: Hot wire rear junction box	30 amps-12 volts;
CB3: Feed rear junction box	70 amps-12 volts;
CB4: Feed front junction box	90 amps-12 volts;
CB5: Hot wire rear junction box	30 amps-24 volts;
CB6: Feed rear junction box	90 amps-24 volts;
CB7: Feed front junction box	90 amps-24 volts.

On all vehicles, optional breakers CB8 & CB9 are installed on evaporator fan junction box located in condenser compartment and can be identified as follows (Fig. 44):

CB8: Condenser fan motor	120 amps;
CB9: Evaporator fan motor	105 amps.

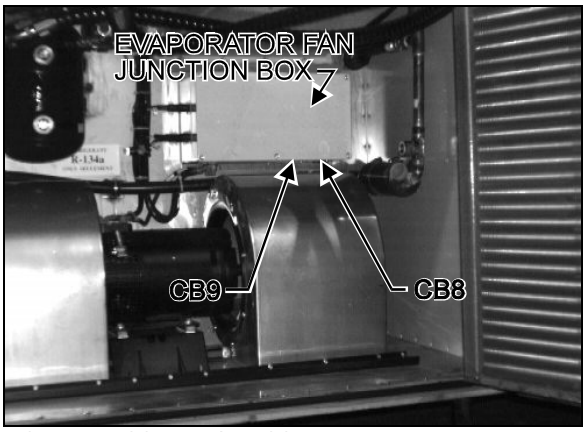


FIGURE 44: CONDENSER COMPARTMENT 06044

4.4.4 R.H. Side Rear Service Compartment

This service compartment is located on rear R.H. side of vehicle aft the rear wheelhousing (Fig. 45). This compartment contains a optional battery equalizer (50-100 amps).

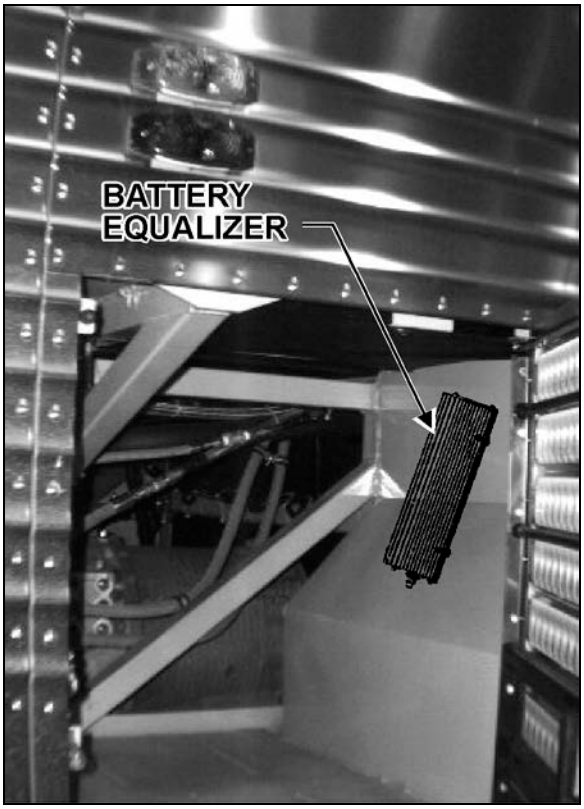


FIGURE 45: R.H. SIDE REAR SERVICE COMPARTMENT 06134

4.4.5 Front Electrical Compartment

The front electrical compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 46):

- relays;
- breakers;
- parking brake alarm;
- level-low;
- diodes.

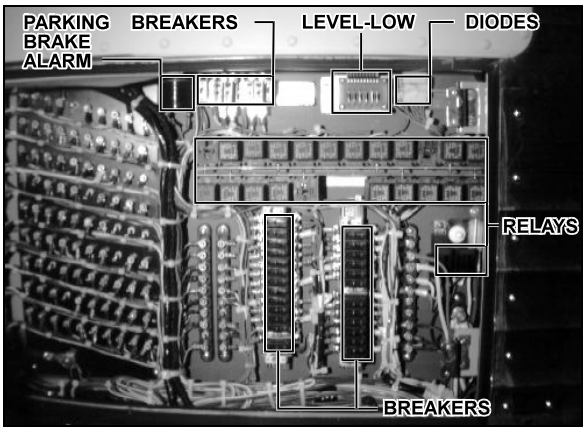
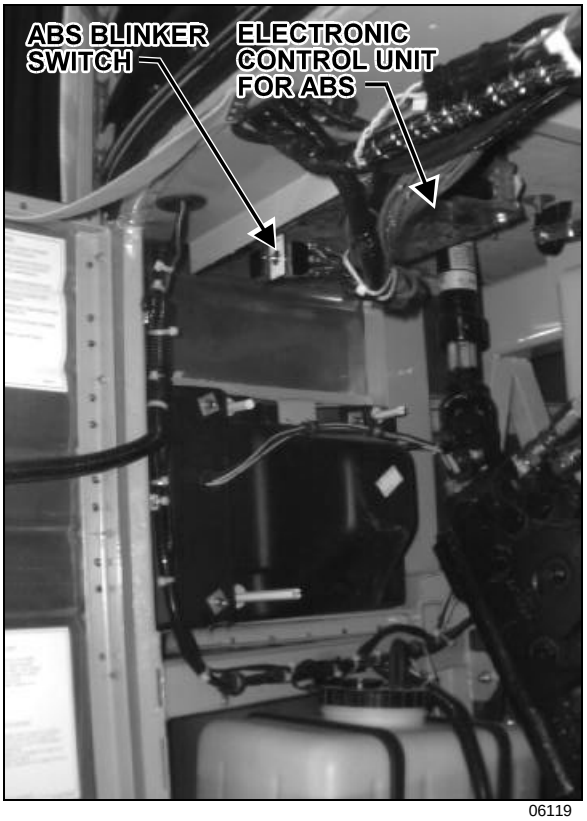


FIGURE 46: FRONT ELECTRICAL COMPARTMENT 06129

4.4.6 Steering Compartment

The front steering compartment is located on L.H. side of vehicle, under the front electrical compartment. It contains the following components (Fig. 47, 48 and 49):

- ABS blinker switch;
- electronic control unit for ABS;
- electronic control unit vehicle interface module;
- electronic control unit for world transmission;
- DDR connector;
- DDEC III junction box;
- speed limit switch module.



06119

FIGURE 47: STEERING COMPARTMENT (LEFT WALL)

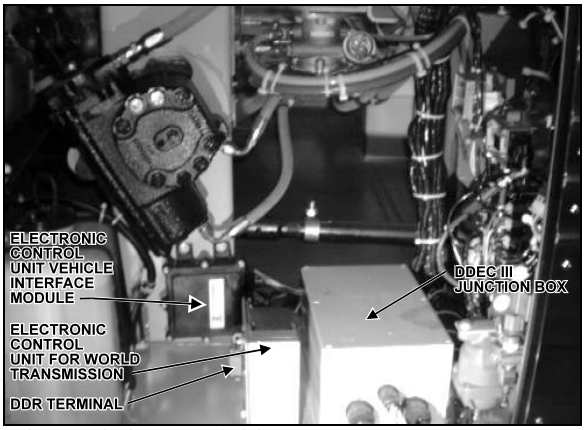


FIGURE 48: STEERING COMPARTMENT 06120

DDR connector

To enhance troubleshooting and to allow interrogation of the ECU for valuable service information, a DDR (diagnostic data reader) can be used. To use it, plug the appropriate connector (not furnished by the manufacturer) in the terminal located in the steering compartment or the connector located on L.H. control panel. You can also use your push-button shifter to perform certain maintenance operations (see Section 01, under paragraph "4. DDEC III Diagnostic codes").

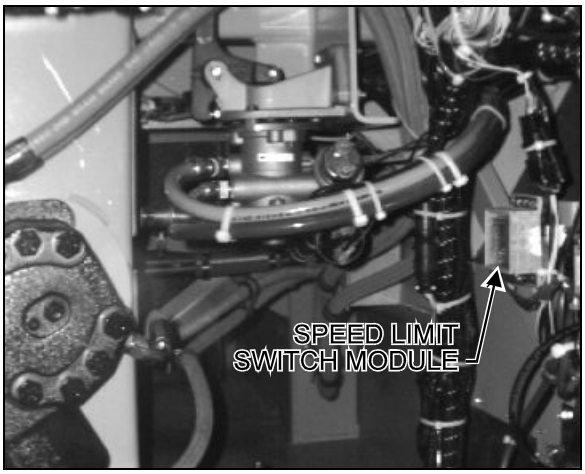


FIGURE 49: STEERING COMPARTMENT 06169

Burned fuses (Fig. 49)

Speed limit switch module.....3 amps (qty=1)

DDEC III Junction Box

The DDEC III Junction Box is located in the steering compartment, on the floor. It contains the following components (Fig. 50):

- connector;
- relays;
- junction block;
- breakers;
- ABS connectors;
- retarder connectors;
- jacob connectors.

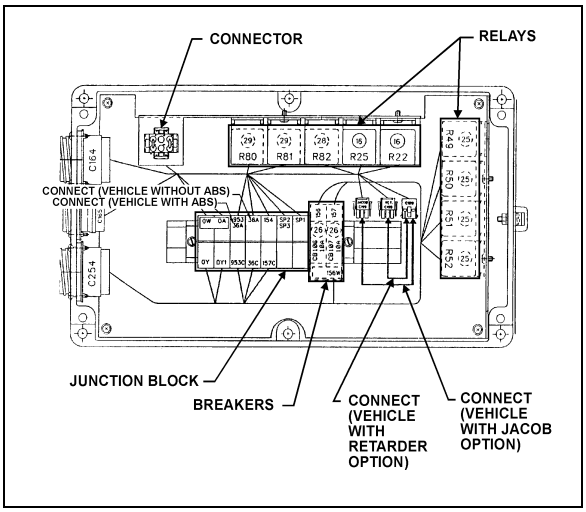


FIGURE 50: DDEC III JUNCTION BOX 06121

4.4.7 Engine Rear Compartment (Rear Junction Box)

The rear junction box is located in the engine rear compartment.

Switches are located on R.H. side of rear junction box (Fig. 51):

- engine compartment lights switch;
- starter selector switch;
- rear start (push button switch).

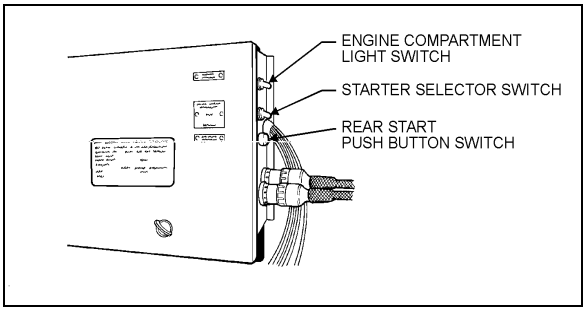


FIGURE 51: REAR JUNCTION BOX SWITCHES 01017

The rear junction box contains the following components (Fig. 52):

- relays;
- breakers;
- diodes;
- relays and resistors;
- time delay relay.

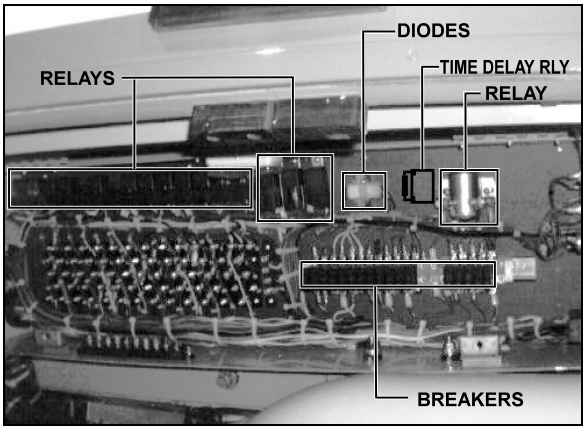


FIGURE 52: ENGINE REAR COMPARTMENT 06135

5. BATTERIES

5.1 General Description

The vehicle is provided with four (4) maintenance-free 12 volts heavy-duty batteries connected in series-parallel. The top-mounted negative and positive terminals are tightly sealed to prevent leaks. Water never needs to be added to this type of battery. There are no filler caps in the cover. The battery is sealed, except for small vent holes in the cover. The vents must not be restricted as they allow small amount of gases that are produced in the battery to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. Besides reducing gassing, the special chemistry greatly reduces the possibility of overcharge damage.

The vents require keeping the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent holes.

Warning: ***DO NOT exceed this 45° angle when carrying or installing the battery.***

Evidence of electrolyte leakage does not necessarily mean the battery is defective.

With special cables properly attached to batteries, the metal surfaces that carry the current are completely sealed from the atmosphere. This prevents terminal oxidation and corrosion that may cause starting and charging problems. If new cables are required, sealed terminal cable replacements should be used to retain the reliability of the original maintenance-free connections.

The battery has four (4) major functions which consist in:

1. Providing a source of current for starting the engine.
2. Stabilizing the voltage in the electrical system.
3. Supplying current for a limited time, when electrical demands of the equipment exceed the power output of the alternator.
4. Providing a limited source of power for connected accessories, when the engine is not running.

5.2 Battery Safety Precautions

When batteries are being charged, an explosive gas mixture forms beneath the cover of each cell. Part of this gas escapes through the holes in the vent plugs and may form an explosive atmosphere around the battery itself if ventilation is poor.

Caution: ***Explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which could shatter the battery. Flying pieces of the battery structure and splash of the electrolyte can cause personal injury. Battery electrolyte is acid. Extreme care should be exercised to avoid skin or eye contact with the electrolyte, wear safety glasses when working near batteries. If you come in contact with battery electrolyte:***

- Flush your skin with water.
- Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water for 10-15 minutes.
- Get medical attention immediately.

5.3 Battery (XL-40 Coach)

5.3.1 Removal

The batteries are located in the rear baggage compartment (battery compartment).

Warning: ***To prevent possible electric shocks or sparking, the main battery disconnect switch should be in the "Off" position before disconnecting cables from the batteries (see paragraph "4.1.3 Battery disconnect switch").***

To remove lower defective batteries:

1. Remove the two (2) batteries retaining bracket nuts. Remove the batteries retaining bracket (Fig. 53).
2. Unscrew terminal nuts of each defective battery. Remove battery cables from the batteries.
3. Remove defective batteries.

To remove the upper battery:

1. Loosen the two (2) rod nuts and remove the battery securing bracket (Fig. 53).

2. Unscrew terminal. Remove battery cables from the battery.
3. Remove defective battery.

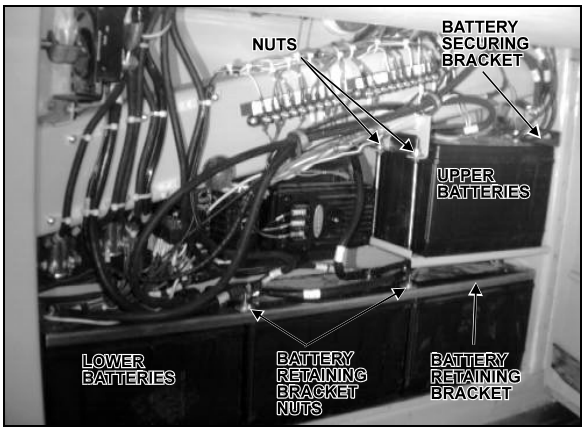


FIGURE 53: BATTERY COMPARTMENT 06136

Note: ***When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.***

5.3.2 Installation

Reverse removal procedure to reinstall the batteries.

Note: ***In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.***

Caution: ***Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.***

When reinstalling batteries, battery connections must be torqued to 10-15 lbf•ft (13-20 N•m. A torque wrench is required to ensure an accurate tightening torque.

Note: ***A protective coating should be applied on all terminals that have been disconnected. and this coating should be clear of silicone. We recommend the use of Cortec VCI-238 (Prévost part #682460) on all electrical connections of the vehicle.***

5.4 Battery (XL- 45 Coach)

5.4.1 Removal

The batteries are located in the main power compartment.

1. Remove the two screws at the bottom of the plastic protective cover, then unscrew the two quarter turn nuts to remove the protective cover.

Warning: ***To prevent possible electric shocks or sparking, the toggle switch or the remote battery master switch should be in the "Off" position before disconnecting cables from the batteries (see paragraph "4.2.2 Main Power Compartment").***

2. Remove the supports, and unscrew terminal nuts of each defective battery.
3. Remove battery cables from the batteries.

Note: ***When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.***

4. Remove batteries.

5.4.2 Installation

Reverse removal procedure to reinstall the batteries.

Note: ***In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.***

Caution: ***Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.***

When reinstalling batteries, battery connections must be torqued to 10-15 lbf•ft (13-20 N•m) and the nut on top of sliding tray to 45-55 lbf•in (5-6 N•m). A torque wrench is required to ensure an accurate tightening torque.

Note: ***A protective coating should be applied on all terminals that have been disconnected. and this coating should be clear of silicone. We recommend the use of Cortec VCI-238 (Prévost part #682460) on all electrical connections of the vehicle.***

5.5 Battery (XL-40 and XL-45E Converted Vehicles)

5.5.1 Removal

The batteries are located in the engine R.H. side compartment (Fig. 54).

1. Remove the tree (3) plastic protective cover retaining bolts. Remove the plastic protective cover.
2. Remove the support retaining bolt.

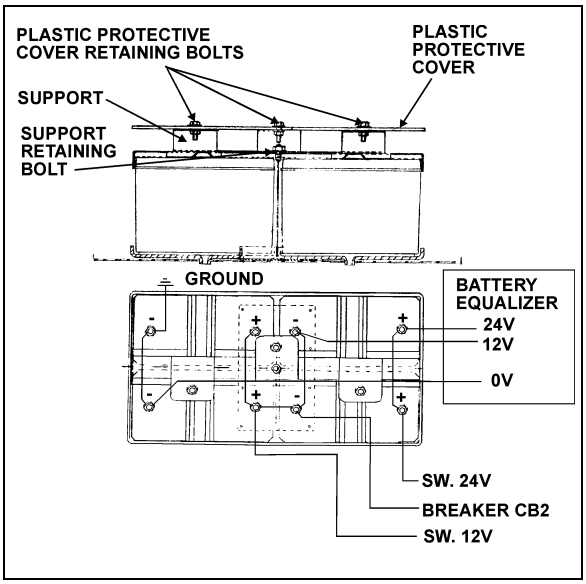


FIGURE 54: BATTERY (XL-40 & XL-45E CONVERTED VEHICLES) 06137

Warning: ***To prevent possible electric shocks or sparking, the 12 and 24 volts main battery disconnect switch should be in the "Off" position before disconnecting cables from the batteries (see paragraph "4.3.2 Engine R.H. Side Compartment").***

3. Remove the support (if necessary, remove battery cables). To remove battery cables, unscrew terminal nuts and remove cables.
4. Remove battery cables from defective batteries.

Note: ***When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.***

5. Remove defective batteries.

5.5.2 Installation

Reverse removal procedure to reinstall the batteries.

Note: ***In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.***

Caution: ***Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.***

When reinstalling batteries, battery connections must be torqued to 10-15 lbf•ft (13-20 N•m). A torque wrench is required to ensure an accurate tightening torque.

Note: ***In engine R.H. side compartment two protective coatings should be applied. On battery terminals we recommend the Nyogel grease (Prévost part #681095). On all other electrical connections that have been disconnected in this compartment, we recommend the protective coating (Prévost part #680745).***

5.6 Battery (XL-45 Converted Vehicle)

5.6.1 Removal

The batteries are located in the engine R.H. side compartment (Fig. 55).

1. Remove the tree (3) plastic protective cover retaining bolts. Remove the plastic protective cover.
2. Remove the J-bolt.
3. Remove the two (2) support retaining bolts.

Warning: ***To prevent possible electric shocks or sparking, the 12 and 24 volts main battery disconnect switch should be in the "Off" position before disconnecting cables from the batteries (see paragraph "4.4.2 Engine R.H. Side Compartment").***

4. Remove the support (if necessary, remove battery cables). To remove battery cables, unscrew terminal nuts and remove cables.
5. Remove battery cables from defective batteries.

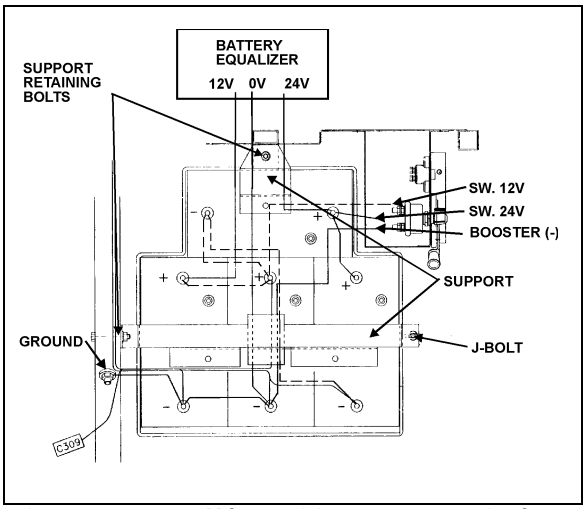


FIGURE 55: BATTERY (XL-45 CONVERTED VEHICLE) 06138

Note: ***When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.***

6. Remove defective batteries.

5.6.2 Installation

Reverse removal procedure to reinstall the batteries.

Note: ***In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.***

Caution: ***Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.***

When reinstalling batteries, battery connections must be torqued to 10-15 lbf•ft (13-20 N•m). A torque wrench is required to ensure an accurate tightening torque.

Note: ***In engine R.H. side compartment two protective coatings should be applied. On battery terminals we recommend the Nyogel grease (Prévost part #681095). On all other electrical connections that have been disconnected in this compartment, we recommend the protective coating (Prévost part #680745).***

5.7 Battery Rating

Each of the 12 volt batteries used on the vehicle has the following rating:

- Reserve capacity: 180 minutes
- Cold cranking (amps): 625 @ 0 °F (-18 °C)
- Cold cranking (amps): 490 @ -20 °F (-29 °C)
- Weight filled: 59 lb. (26,7 kg)

The reserve capacity is defined as the number of minutes a new, fully charged battery at 80 °F (26,6 °C) can be discharged at 25 amperes and maintain a minimum of 1.75 volts per cell (10.5 volts total for one 12 volts battery). This rating can be used as a basis for determining how long a vehicle might run after an alternator failure.

The cold cranking rating is defined as the minimum discharge current a battery will deliver in amperes for 30 seconds at 0 °F (-18 °C) while maintaining a minimum of 1.2 volts per cell (7.2 volts total for one 12 volts battery). This rating can be used as a basis for comparing starting performance.

5.8 Battery Testing

The maintenance-free battery has a strong ability to withstand the damaging effects of overcharge. The test indicator in the cover is used only to determine if the battery can be tested in case of a cranking problem.

The test indicator in the battery cover is to be used with accepted diagnostic procedures only (Fig. 56). It must not be used to determine if the battery is good or bad, or charged or discharged. The test indicator is a built-in hydrometer in one cell which provides visual information for battery testing.

It is important when observing the test indicator, that the battery be relatively level and has a clean indicator top to see the correct indication. A light may be required in some poorly lit areas. Under normal operation, two indications can be observed.

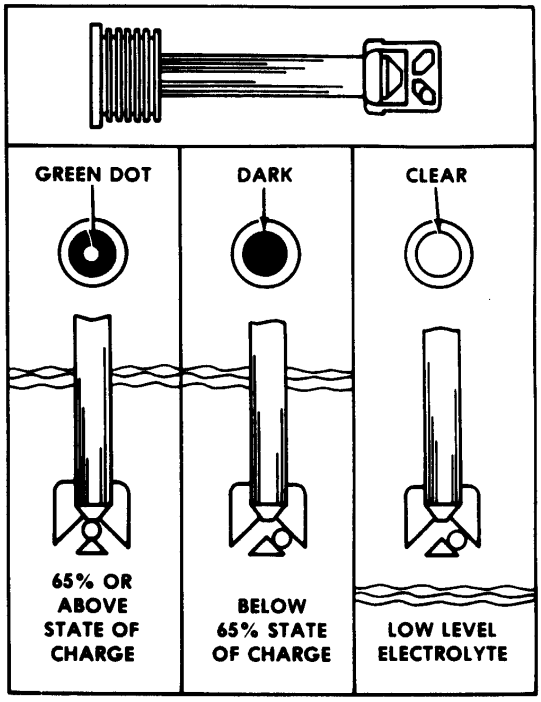


FIGURE 56: TEST INDICATOR 06096

Green Dot Visible

Any green appearance is interpreted as a *"green dot"*, and the battery is ready for testing. On rare occasions, following prolonged cranking, the green dot may still be visible when the battery is obviously discharged. Should this occur, charge the battery as described under *"Charging Procedure"* in *"Battery Charging"* later in this section.

Dark - Green Dot Not Visible

If a cranking complaint is encountered, the battery should be tested as described in this section. On rare occasions, the test indicator may turn light yellow. In this case, the integral charging system should be checked. Normally, the battery is capable of further service; however, if a cranking complaint has been reported, replace the battery. **DO NOT CHARGE, TEST, OR JUMP-START.**

5.8.1 Visual Inspection

1. Check the outside of the battery for a broken or cracked cover or case that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery.
2. Check for loose terminal posts, cable connections, damaged cables, and for evidence of corrosion; correct conditions as required before proceeding with tests.

5.8.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in figure 58. Connect a 300 amperes load across the terminal for 15 seconds to remove surface charge from the battery.

5.8.3 Load Test

This test is one means of checking the battery to determine its ability to function as required in the vehicle.

To make this test, use test equipment that will withstand a heavy electrical load from the battery, such as a carbon pile resistor or other suitable means.

1. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in figure 57.

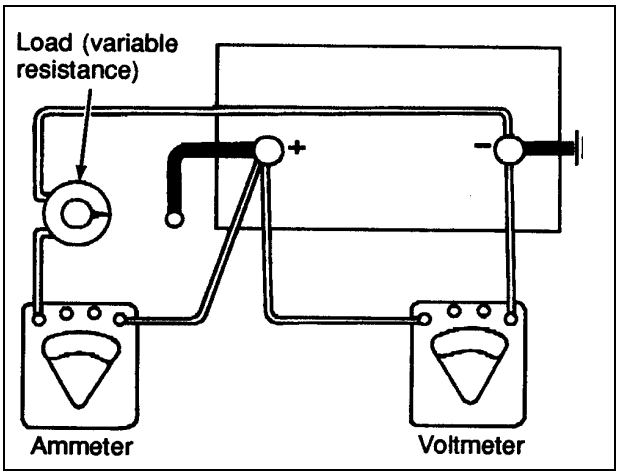


FIGURE 57: LOAD TEST 06064

Caution: ***Observe polarity of the meters and the battery when making connections, and select the correct meter range.***

2. Apply a 290 amperes load to the battery for 15 seconds.
3. With an ammeter reading specified load, read voltage. The voltage should be at least 9.6 volts. Disconnect the load. If the voltmeter indicates 9.6 volts or more, the battery is good. If the voltmeter reading is less than 9.6 volts, replace the battery. This voltage is to be used for battery ambient temperatures of 70 °F (21 °C) and above. For temperatures below 70 °F (21 °C), refer to the following *"Voltage and Temperature Chart"*.

Voltage and Temperature Chart

Ambient Temperature	Minimum Voltage
70 °F (21 °C) and above	9.6
60 °F (16 °C)	9.5
50 °F (10 °C)	9.4
40 °F (4 °C)	9.3
30 °F (-1 °C)	9.1
20 °F (-7 °C)	8.9
10 °F (-12 °C)	8.7
0 °F (-18 °C)	8.5

Note: ***The accuracy of this test procedure is dependent upon close adherence to the proper load, time and temperature specifications.***

5.8.4 Testing Battery Cables

Check all cable ring terminals and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces an abnormal voltage drop which may lower voltage at the starting motor to such a low value that normal operation of the starting motor will not be obtained. An abnormal voltage drop can be detected with a low-reading voltmeter as follows:

Warning: ***To prevent the engine from starting, the DDEC engine circuits, which are protected by breakers (CB-19, CB-20 and CB-21) located in the engine rear compartment (rear juntion box), must be deenergized during these tests; afterwards, depress black button to close circuit.***

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame by placing one prod of the voltmeter on the battery terminal and the other on a good ground (unpainted surface) on the vehicle. With the starting motor cranking the engine at a temperature of 70 °F (21 °C), voltage reading should be less than 0.3 volt. If the voltage reading exceeds 0.3 volt, there is excessive resistance in this circuit.
2. Check voltage drop between the positive battery terminal and the starting motor positive terminal stud while the motor is operated. If the reading is more than 2.5 volts, there is excessive resistance in this circuit.

Note: ***If it is necessary to extend the voltmeter lead for this test, use a #16 (AWG) or larger wire.***

3. Check voltage drop between the starting motor housing and a good ground on the vehicle. The reading should be less than 0.2 volt.

Warning: ***Any procedure other than the following could cause personal injuries or damages to the charging system resulting from battery explosion or electrical burns.***

Wear adequate eye protection when working on or near the batteries. Ensure that metal tools or jumper cables do not contact the positive battery terminal (or a metal surface in contact with it) as a short circuit will result.

Do not attempt to jump start a vehicle suspected of having a frozen battery because the battery may rupture or explode.

Both the booster and discharged batteries must be treated carefully when using jumper cables. Follow exactly the procedure outlined later in this section, being careful not to cause sparks.

5.9 Battery Charging

Warning: ***During charging of the batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through the vent holes and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which may shatter the battery.***

Do not smoke near a battery which is being charged or which has been recently charged.

Do not break live circuits at battery terminals because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on chargers. Poor connections are a common cause of electric arcs which cause explosions.

The electrical system on this vehicle is negative ground. Installing the batteries with the positive terminals grounded or incorrect use of the booster battery and jumper cables will result in serious damage to the alternator, batteries and battery cables.

5.9.1 Charging Procedure

The batteries used on this vehicle can be charged either on or off the vehicle; however, when they are removed from the vehicle, it is recommended that an adapter kit, which is available from any *"A/C DELCO"* dealer, be used in charging sealed-terminal batteries. To remove batteries, see paragraph "5. Batteries" in this section.

The alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs (Fig. 58) after the vehicle cables are detached.

The alligator clamps should make firm contact with the lead pads.

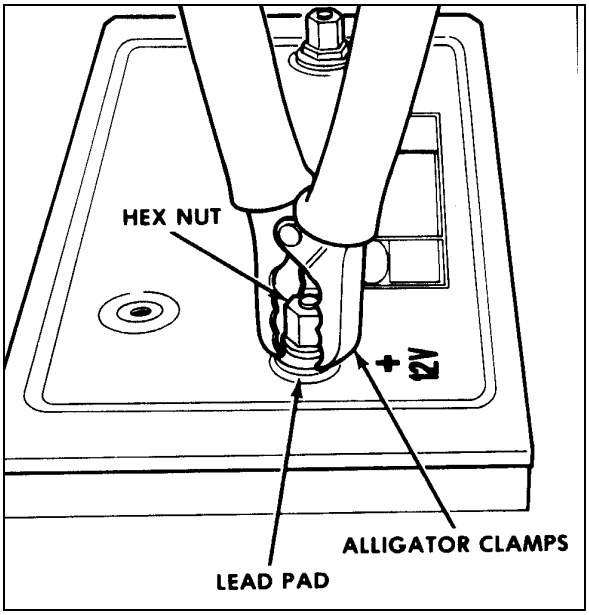


FIGURE 58: ALLIGATOR CLAMPS & BATTERY 06065

Note: ***If this connection cannot be made because of the alligator clamp design, the load value for testing must be reduced from 290 to 260 amperes.***

On rare occasions, such as those that occur following prolonged cranking, the green dot in the test indicator may still be visible when the battery is obviously discharged. Should this occur, a boost charge of 20 amperes-hour is recommended. Under normal operating conditions, do not charge battery if the green dot is visible. The battery should never be charged if the test indicator (hydrometer) is clear or light yellow. If this occurs, replace the battery.

A charge rate between 3 and 50 amperes is generally satisfactory for any maintenance-free battery as long as spewing of electrolyte does not occur or the battery does not feel excessively hot (over 125 °F (52 °C)). If spewing or violent gassing of electrolyte occurs or battery temperature exceeds 125 °F (52 °C), the charging rate must be reduced or temporarily stopped to allow cooling and to avoid damaging the battery.

Battery temperature can be estimated by touching or feeling the battery case. The battery is sufficiently charged when the green dot in the built-in hydrometer is visible. No further charging is required. Shake or tilt the battery at hourly intervals during charging to mix the electrolyte and see if the green dot appears.

Warning: ***Always turn off the charger before connecting or disconnecting it to or from a battery.***

Note: ***The charge rate must be doubled when the batteries are charged by the booster block, since we have a series-parallel circuit.***

Battery charging consists of a charge current in amperes for a period of time in hours. Thus, a 25 amperes charging rate for 2 hours would be a 50 amperes-hour charge to the battery. Most batteries, whose load test values are greater than 200 amperes, will have the green dot visible after at least a 75 amperes-hour charge. In the event that the green dot does not appear, replace the battery.

Use the booster block to charge the batteries when they are left on vehicle.

Set to the "On" position the:

- Main battery disconnect switch (XL-40 coach);
- Toggles switch and the battery master switch (XL-45 coach);
- 12 and 24 volts main battery disconnect switch (XL-40, XL-45E and XL-45 converted vehicles).

Refer to paragraph "4. Electrical Compartments" for booster block locations.

5.9.2 Battery Charging Guide

Fast Charging Rate

20 amps @ 3-3/4 hours
30 amps @ 2-1/2 hours
40 amps @ 2 hours
50 amps @ 1-1/2 hours

Slow Charging Rate

5 amps @ 15 hours
10 amps @ 7-1/2 hours

The time required for a charge will vary according to the following factors:

Size of Battery

For example, a completely discharged large heavy-duty battery requires more than twice the recharging time of a completely discharged small passenger car battery.

Temperature

For example, a longer time will be needed to charge any battery at 0 °F (-18 °C) than at 80 °F (27 °C). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, then in time, the battery will accept a higher rate as it warms.

State of Charge

For example, a completely discharged battery requires more than twice as much charge than a half-charged battery. Since the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

Charger Capacity

For example, a charger which can supply only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.

5.9.3 Emergency Jump Starting With Auxiliary (Booster) Battery

Whenever it becomes necessary to start the engine while batteries are discharged, use another power source of the same voltage (24 volt DC), negative grounded and proper jumper cables.

Warning:

- ***Jump starting may be dangerous and should be attempted only if the following conditions are met.***
- ***Never connect to the negative post of the discharged battery.***
- ***Never allow the two vehicles or the jumper cable clamps to touch each other.***
- ***Never attempt to jump start a vehicle if the discharged battery fluid is frozen or if the battery fluid level is low, as the battery may rupture or explode.***
- ***Do not jump start vehicles equipped with maintenance-free batteries if the test indicator is light yellow.***
- **Turn off all lights, heaters and other electrical accessories. Make sure the parking brake is applied and the transmission is set to "NEUTRAL" before attempting to jump start the engine.**
- ***The booster battery or the battery in the other vehicle must be of the same voltage as the battery in the vehicle being started, and must be negative grounded.***
- ***If the booster battery is a sealed-type battery without filler openings or caps, its test indicator must be dark or a green dot must be visible. Do not attempt jump starting if the test indicator of the booster battery or the discharged battery has a light or bright center.***
- ***Wear eye protection and remove rings, watches with metal bands and other metal jewelry.***
- ***Follow exactly the procedure outlined below, being careful not to cause sparks***
- ***Procedures other than the one outlined below could cause injury or damage from battery acid spray, explosion, or charging system overload.***

1. Connect one end of the red jumper cable to the positive (+) post of the booster power source.

2. On **XL-40 & XL-45E CONVERTED VEHICLES**, remove the grey protective sealant from the 24 volt battery disconnect switch post, then connect the other end of the red jumper cable to this post according to the figure 59 (it may be necessary to also remove the insulating varnish on the battery switch disconnect post).

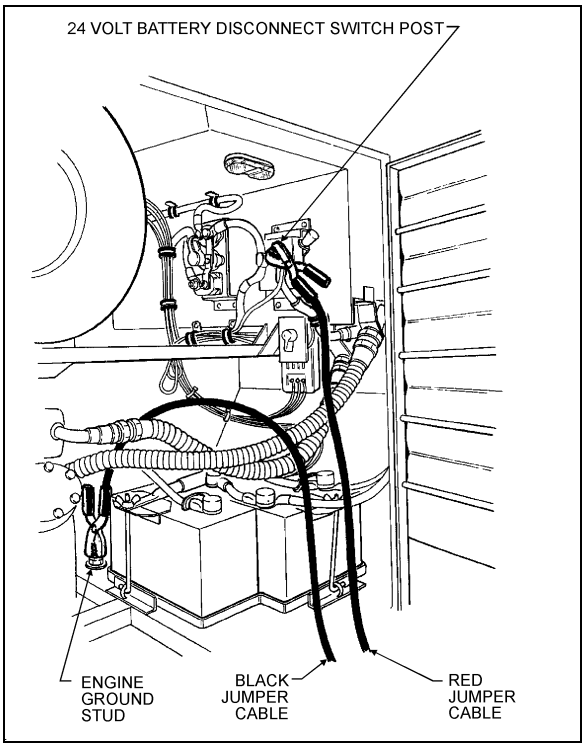


FIGURE 59: BOOSTER BLOCK (XL-40 and XL-45E CONVERTED VEHICLES) 06046

2. On**, XL-40 COACH, XL-45 COACH AND XL-45 CONVERTED VEHICLE.** Remove the red protective cap from Booster Block's Positive Stud, then connect the other end of the red jumper cable to this stud (see illustrations on this page).

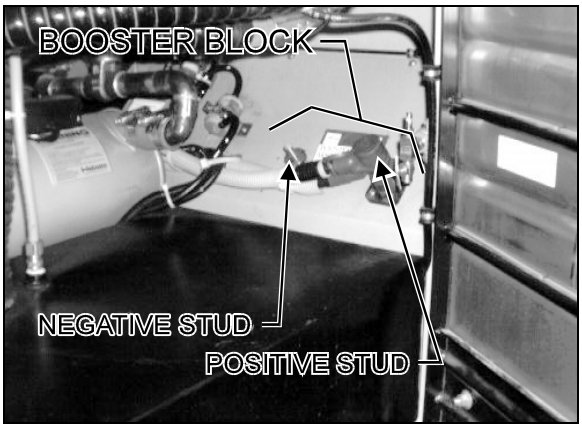


FIGURE 60: BOOSTER BLOCK (XL-40 COACH) 06098

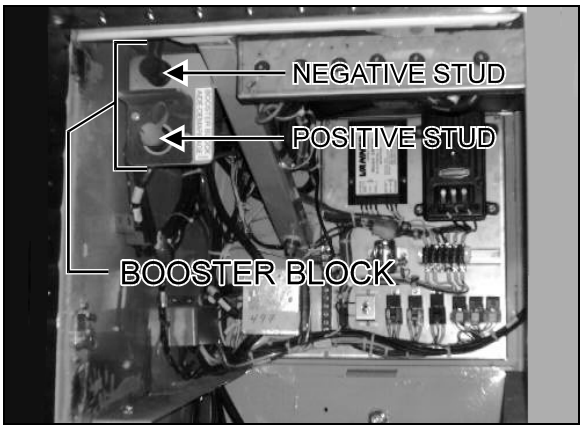


FIGURE 61: BOOSTER BLOCK (XL-45 COACH) 06097

FIGURE 62: BOOSTER BLOCK (XL-45 CONVERTED VEHICLE) 06045

3. Connect one end of the black jumper cable to the negative (-) post of the booster power source.

4. On **XL-40 & XL-45E CONVERTED VEHICLES**, remove the grey protective sealant from the engine ground stud fixed on frame, then connect the other end of the black jumper cable to this stud as shown on figure 59.

5. On **XL-45 CONVERTED VEHICLE, XL-40 AND XL-45 COACHES**. Remove the black protective cap from Booster Block's Negative Stud, then connect the other end of the black jumper cable to this stud (see illustration on this page).

6. Start the engine in the vehicle that is providing the jump start. Let the engine run for a few minutes, then start the engine in the vehicle that has the discharged batteries.

***Warning**: Do not engage starter for more than 15 seconds. Allow starter time to cool before engaging again. This will prevent starter from overheating and will allow time delay relay to cool.*

7. To remove the cables, perform the above procedure in reverse order, then replace the protective sealant, if possible.

***Note:** Jumper cables must withstand 500 cranking amperes. If cable length is 20 feet (6 m) or less, use 2/0 (AWG) gage wires. If cable length is between 20-30 feet (6-9 m), use 3/0 (AWG) gauge wires.*

***Note**: If, after doing this procedure, Starter turns but Engine still doesn't run; (with Jumper Cables in place) wait approximately 15 minutes (to give battery equalizers time to balance 12V and 24V charges), then try again. If engine still doesn't run, repeat procedure once again.*

5.10 Cleaning and Inspection

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down clamp bolts should be kept properly tightened. For best results when cleaning the battery, wash first with a diluted solution of ammonia or soda to neutralize any acid present, then wash out with clean water. The battery hold-down bolts should be kept tight enough to prevent the batteries from moving, but they should not be tightened to the point that excessive strain is placed on the battery hold-down cover (proper tightening torque: 45-55 lbf•ft (5-6 N•m)).

To insure good contact, the battery cable ring terminals should be tight on the battery posts. If the posts or cable ring terminals are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush (refer to paragraph "5. Batteries" in this section for battery removal and installation. Install cable ring terminals on battery posts and tighten to a torque of 10-15 lbf•ft (13-20 N•m), then replace protective caps to prevent corrosion and sparks.

5.11 Common Causes of Battery Failure

When a battery fails, the cause of failure may be linked to something other than the battery. For this reason, when a battery failure is encountered, do not be satisfied with merely recharging or replacing battery. Locate and correct the cause of the failure to prevent recurrence. Some common external causes of battery failure are as follows:

1. Defect in charging system such as high resistance or a faulty alternator or regulator.
2. A malfunction within the 12 volts system (equalizer).
3. Overloads caused by a defective starter or excessive use of accessories.
4. Dirt and electrolyte on top of the batteries causing a constant drain.
5. Hardened battery plates, due to battery being in a low state of charge over a long period of time.
6. Shorted cells, loss of active material from plates.
7. Driving conditions or requirements under which the vehicle is used only for short drives.
8. A constant drain caused by a shorted circuit such as an exposed wire or water infiltration in junction boxes causing ground fault.
9. Extended operation of preheating system without engine running.
10. Omission of closing disconnect switches for an extended period of time.

5.12 Troubleshooting

If a battery has tested good and then has not performed satisfactorily in service for no apparent reason, the following factors may point to the cause of trouble:

1. Vehicle accessories and the following disconnect switch, inadvertently left on overnight :

- Main battery disconnect switch (XL-40 coach);
- Toggles switch and the battery master switch (XL-45 coach);
- 12 and 24 volts main battery disconnect switch (XL-40, XL-45E and XL-45 converted vehicles).

2. Defects in the charging system, such as high wiring resistance, faulty alternator, regulator or battery equalizer.

3. A vehicle electrical load exceeding the alternator (or battery equalizer) capacity, with the addition of electrical devices, such as CB radio equipment, a cellular phone or additional lighting system.
4. Defects in the electrical system, such as shorted or pinched wires.
5. Extended slow speed driving with many accessories turned on.
6. Loose or poor battery cable-to-post connections, previous improper charging of a run-down battery, or loose hold-down clamp bolts.
7. High-resistance connections or defects in the cranking system.

6. ELECTRICAL SYSTEM MONITOR

This vehicle is equipped with an electronic device that monitors and detects abnormal alternator, voltage regulator, battery banks or battery equalizers conditions. Refer to paragraph "4. Electrical compartment" for monitor location. The *"Battery balance"* and *"Battery Hi/Lo"* warning lamps connected to this module are mounted in dashboard (refer to *"Operator's Manual"* for location). If a malfunction should occur, the monitor sends a signal to the driver by means of the appropriate warning light according to the malfunctioning component. If the *"Battery Hi/Lo"* warning light is illuminated, check the 24 volt voltmeter to determine if battery voltage is too high or too low.

Note: ***According to battery charging condition, it is normal that "Battery Hi/Lo" warning light illuminates upon starting the engine and stays illuminated a few seconds. This is caused by the battery normal voltage drop during starting.***

6.1 Warning Lamp Definitions

6.1.1 Battery Hi/Lo

Voltmeter drops below 24 V dc
- Check alternator output
- Check voltage regulator
- Check battery connections
- Check battery cells
- Check battery equalizers connections

Voltmeter exceeds 30 V dc
- Check alternator output
- Check voltage regulator
- Check battery connections

6.1.2 Battery Balance

Note: ***Allow at least 15 minutes to balance batteries after corrective measure has been taken.***

1. **Batteries out of balance (difference greater than 1.5 volts between the two battery banks)**
   - Check battery equalizer connections
   - Check equalizer cables for proper gauge
   - Check battery connections
2. **Demand for 12 volts power exceeding rated amperage output of battery equalizers causing batteries to go out of balance**
   - Reduce 12 volts load or install additional battery equalizer(s)

6.1.3 "Battery" Warning Light

This warning light is not controlled by the electronic monitor, but by the "R" terminal of the alternator using the normally-closed contact of the relay R-33. If a voltage drop should develop in the charging system, the *"Battery"* warning light will immediately light up to warn the driver and will be followed by the illumination of the *"Battery Hi/Lo"* warning light if the voltage drops below 24 V dc.

Refer to heading *"Diagnosis of charging system problems"* later in this section, to determine weather the alternator or the voltage regulator is defective. Should the *"Battery"* warning light illuminate while the 24 volts voltmeter keeps on giving a normal reading and the *"Battery Hi/Lo"* warning light does not illuminate, the relay R-33 or its wiring is probably defective.

Caution: ***The relay R-33 should never be replaced with a relay provided with a suppressor diode on its coil as the output current (between 12 and 14 volts) at the alternator "R" terminal is not rectified, thus rendering relay inoperative.***

Note: ***When the "Battery" warning light illuminates, the "A/C & Heating" system shutts off in order to prevent battery discharge.***

7. ALTERNATOR

The battery-charging alternator(s) are introduced into the electrical system to provide a source of electrical current for maintaining the storage battery in a charged condition and to supply sufficient current to carry any other electrical load requirements up to the rated capacity of the alternator(s).

The battery-charging circuit consists of alternator(s), voltage regulator, batteries, battery equalizer(s) and the connecting wiring. They are described under the applicable headings hereafter.

7.1 Gear Driven Alternator-Oil Cooled (24V-270 Amps)

The gear driven alternator-oil cooled is located in engine compartment and mounted on the engine (Fig. 63).

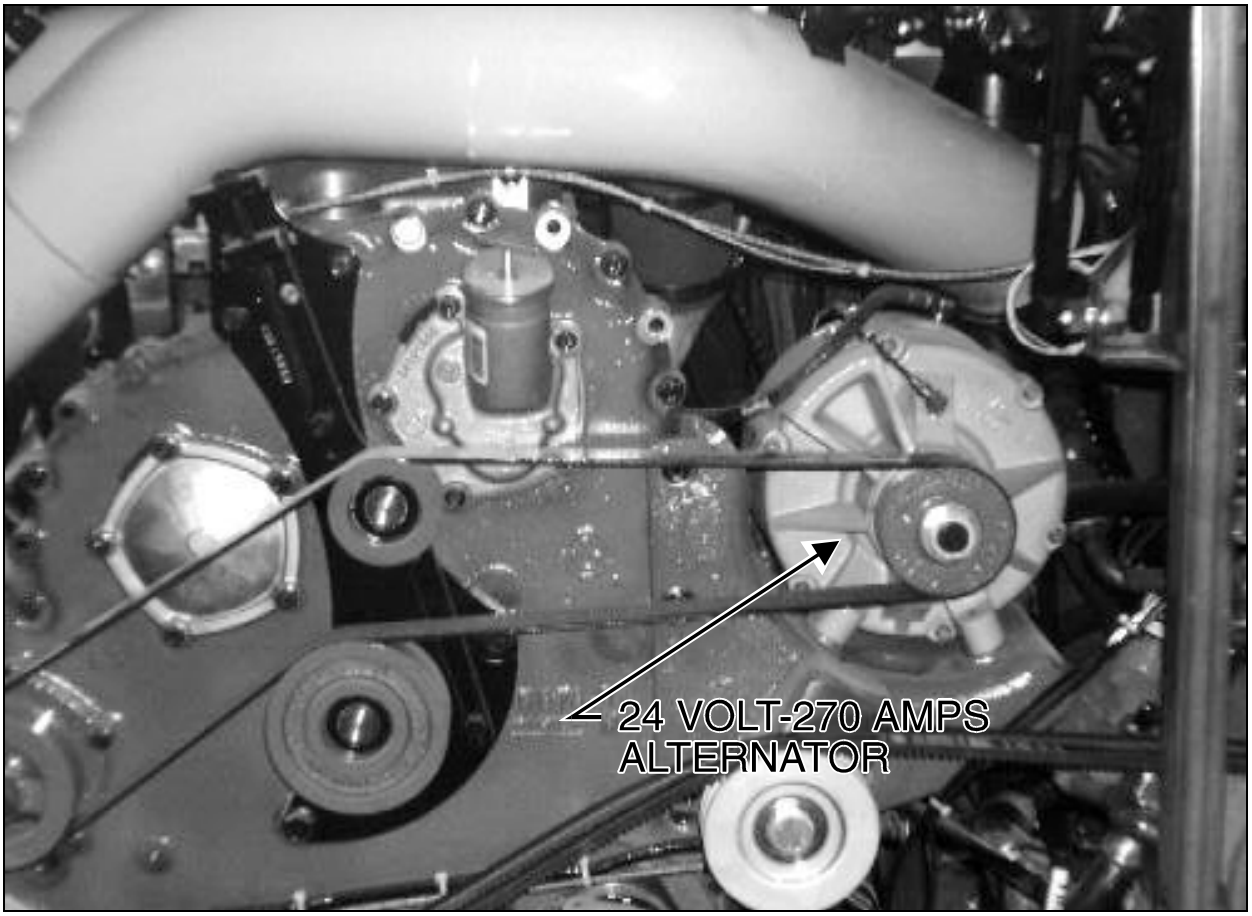


FIGURE 63: ENGINE REAR COMPARTMENT (ALTERNATOR) 06139

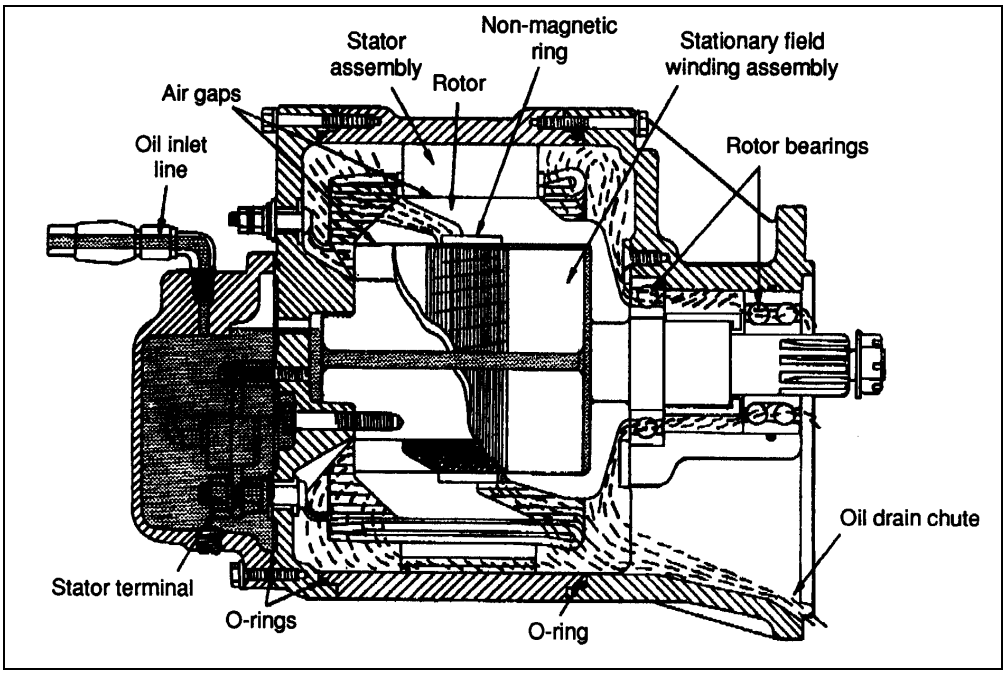


FIGURE 64: ALTERNATOR 06066

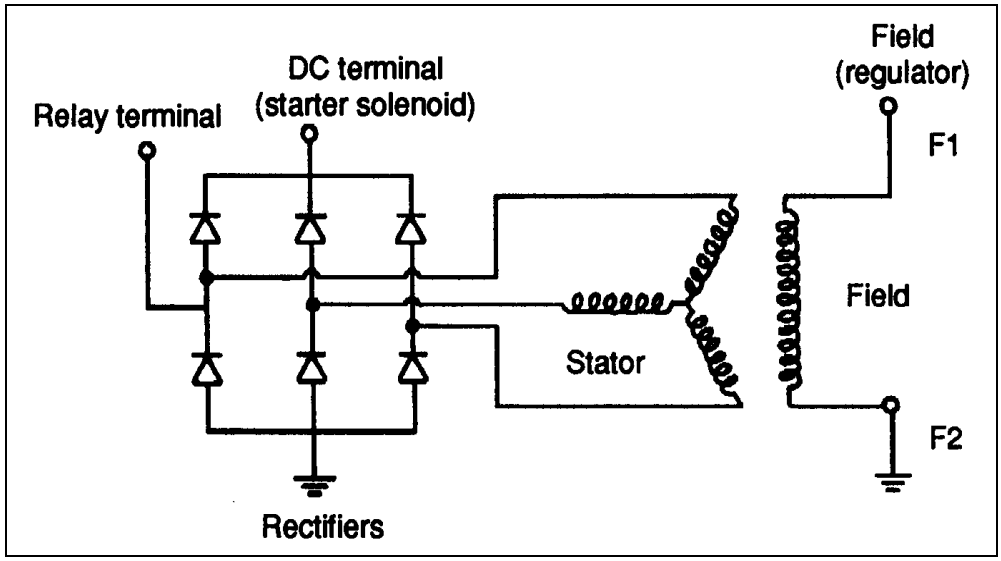


FIGURE 65: ALTERNATOR WIRING DIAGRAM 06067

This alternator is of the self-rectifying type in which all current carrying members, windings, built-in diodes, and field coils are stationary. The only moving component is the rotor. The alternator is a totally-enclosed unit, cooled and lubricated by engine oil (Fig. 64). The oil inlet is on the diode end cover. The oil drains back into the engine crankcase through the drive end frame and drive adapter housing. The alternator should never be operated with the oil supply line disconnected. A continuous flow of engine oil flows through the alternator to lubricate the bearings and cool the assembly.

Four terminals are used on this alternator: the DC output terminal, two field terminals, and a 12 volt relay terminal (Fig. 65). The alternator output voltage is regulated by a separate 24 volts regulator that controls the alternator field current.

Note: The relay coils connected to the alternator "relay terminal" SHOULD NEVER BE PROVIDED WITH A SUPPRESSOR DIODE as the output current at this terminal is not rectified, thus rendering relay inoperative.

Caution: The electrical system is NEGATIVE GROUND. Connecting the batteries or a battery charger with the positive terminal grounded will endanger the alternator diodes and vehicle wiring by a high current flow. Burned wiring harness and burned "open" diodes will result. Always ensure that the alternator and battery polarities are matched prior to installation. THE ALTERNATOR WILL NOT REVERSE TO ACCEPT INVERSE POLARITY. Also, do not ground or short across any of the alternator or regulator terminals.

Since there are no brushes, slip rings, or rubbing seals, the alternator requires no periodic maintenance other than the following:

1. Check alternator-to-engine mounting bolts for looseness and tighten to the proper torque.

2. Check all electrical connections for tightness and corrosion. Clean and tighten connections as necessary. Be sure wiring insulation is in good condition and that all wiring is securely clipped to prevent chafing the insulation.

3. With the engine running, listen for noise and check the alternator for vibration. If the alternator is noisy or vibrates excessively, it should be removed for inspection and repair.

4. Ensure that battery terminals are clean and tight.

7.2 Diagnosis of Charging System Problems

The troubleshooting of the charging system is made easier by the use of a 12 and a 24 volts voltmeters, *"Battery"*, *"Battery balance"* and *"Battery Hi/Lo"* warning lights mounted in dashboard (for location refer to the *"Operator's Manual"*). The definition of each warning light is explained under the paragraph "6. *Electrical System Monitor"*.

7.2.1 Alternator or Voltage Regulator

To determine which unit is faulty, proceed as follows:

1. Start the engine and momentarily connect a jumper from the "F1" field terminal to "DC (+)" terminal. For connections, refer to figure 66.

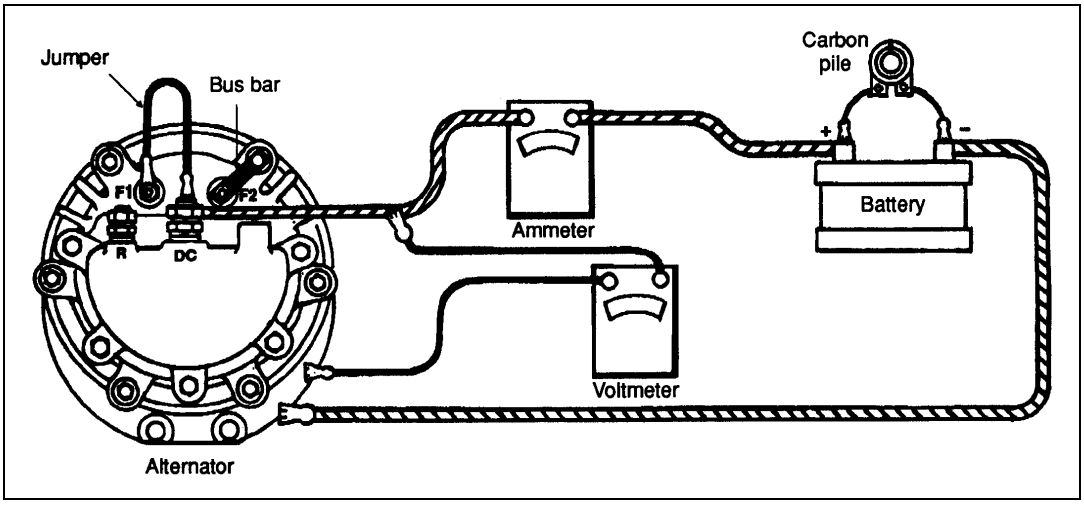


FIGURE 66: ALTERNATOR 06068

Caution: ***Do not feed the alternator field "F1" terminal for more than 10 seconds. High voltage could burn out the wires and components of charging system, and seriously damage the alternator.***

Do not jump the "F2 (-)" terminal with the "DC (+)" terminal on the alternator. This will result in a direct short circuit.

a) If the voltmeter readings increase, trouble is located in the 24 volts regulator or wiring. Check the regulator as explained under "Voltage regulator" later in this section.

b) If the voltmeter readings do not increase, the problem may be in the alternator.

7.3 Alternator Diagnosis

***Caution:* Before checking the alternator, TURN OFF the:**

- ***Main battery disconnect switch (XL-40 coach);***
- ***Toggles switch and the battery master switch (XL-45 coach);***
- ***12 and 24 volts main battery disconnect switch (XL-40, XL-45E and XL-45 converted vehicles).***

It is not necessary to disassemble completely the alternator to make electrical checks. All electrical checks are made at the diode end of the assembly without having to remove the rotor, drive end frame or bearing. If the electrical components are not defective, but bearing replacement is necessary, this can be done at the drive end without having to disassemble the diode end of the unit.

The components in the alternator which require electrical checks are the field winding, the six diodes, and the stator winding.

7.3.1 Diode Checks

Each diode may be checked for shorts and opens as follows:

***Caution:* Before checking diodes, TURN OFF the:**

- ***Main battery disconnect switch (XL-40 coach);***
- ***Toggles switch and the battery master switch (XL-45 coach);***
- ***12 and 24 volts main battery disconnect switch (XL-40, XL-45E and XL-45 converted vehicles).***

1. Remove the pipe plug from underneath the end housing to drain the oil in the rectifier engine oil supply.
2. Remove the cap screws (7) and lock washers which attach the diode end cover to the end housing. Remove the end cover from the end housing.

***Note:* Do not operate the alternator unless this unit is completely reassembled.**

3. Remove seal from the end housing, detach and remove "DC" and relay terminals, stud, insulating sleeves and O-rings.
4. Disconnect all diode flexible leads, i.e. three from the output terminal stud and three from the diode supports. See figure 67 for more details.

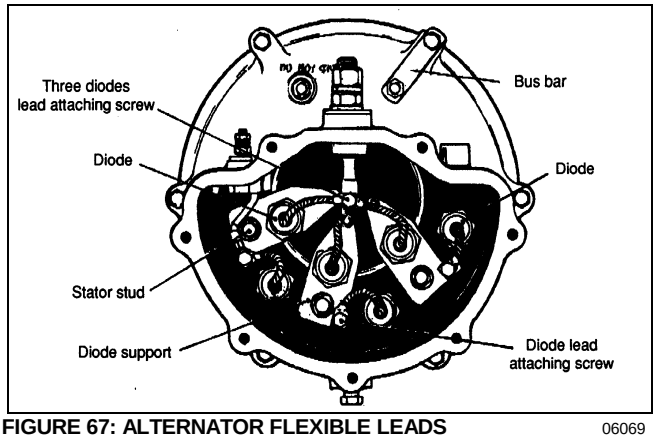


FIGURE 67: ALTERNATOR FLEXIBLE LEADS 06069

Each diode may be checked for shorts and opens with an ohmmeter.

Note: ***The ohmmeter polarity may be determined by connecting its leads to the voltmeter leads. The voltmeter will read up-scale when the negative leads are connected together and the positive leads are connected together. The polarity of the voltmeter leads may be determined by connecting the leads to the identified terminals on a battery.***

Note: ***Use an ohmmeter with a single 1.5 volts cell. Most accurate reading will be determined when the 300 ohms value is calibrated to the center one-third of the scale. DO NOT USE high voltage, such as a 110 volts test lamp to check diodes.***

To check diodes mounted in the supports for shorts, connect the positive ohmmeter lead to each diode lead and the ohmmeter negative lead to each support as shown in "A", "B", and "C" of figure 68. To check diodes mounted in the end frame for shorts, connect the ohmmeter positive lead to each diode lead and the ohmmeter negative lead to the end frame as shown in parts "D", "E", "F". The ohmmeter readings may vary considerably when checking diodes for shorts, but if the reading is 300 ohms or less, the diode is likely defective and should be replaced. If the diode reads 300 ohms or less, it will allow excessive reverse current from the battery. Replace defective diodes as explained later in this section.

To check the diodes mounted in the diode supports for opens, connect the ohmmeter negative lead to each diode lead and the ohmmeter positive lead to each support as shown in parts "A", "B", and "C" of figure 69. To check the diodes mounted in end frame for shorts, connect the ohmmeter negative lead to each diode lead and the ohmmeter positive lead to the end frame as shown in parts "D", "E" and "F". An infinite resistance reading indicates an open diode. Diodes can be replaced by following the procedure outlined under the paragraph *"7.4 Diode Replacement"*.

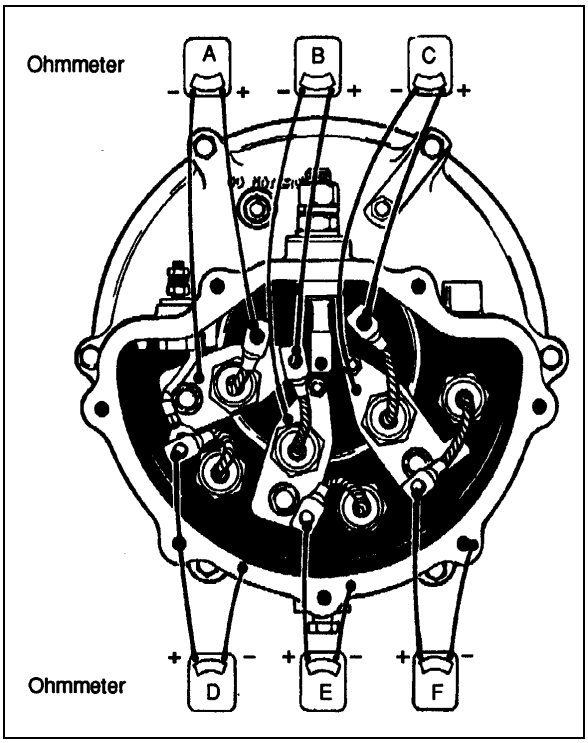


FIGURE 68: DIODES TEST 06070

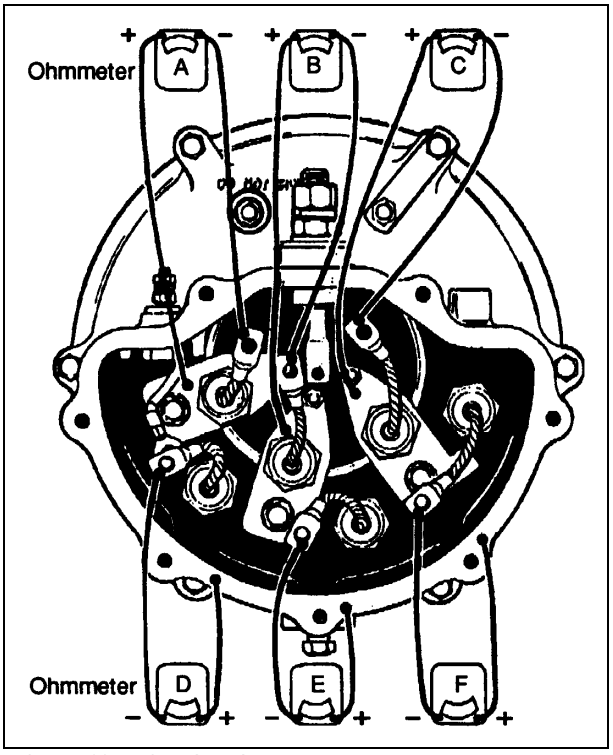


FIGURE 69: DIODES TEST 06071

When reinstalling diodes, torque to 9-11 lbf•ft (12-15 N•m). Re-stake next to the threads in an arbor press with an 1/8 inch (3,2 mm) round punch. Press the punch with gradual pressure; do not strike as the shock may damage the diodes.

7.3.2 Field Winding Checks

The field winding may be checked for shorts and opens with an ohmmeter. To check the field winding, connect the ohmmeter to field terminal and to ground. A resistance reading above normal indicates an open, and a reading less than normal indicates a short. The normal resistance value is 3.0 to 3.3 ohms at 80 °F (27 °C). An alternate method of checking is to place a battery of specified voltage, and an ammeter in series with the field winding. The current should register 7.2 to 8.3 amperes at 24 volts. Coil resistance is approximately 3.1 ohms. Amperage readings, other than the above, indicate an open, grounded, or shorted field. A defective field coil can be replaced by removing the end frame on which the field terminal is located and then removing the four field coil mounting screws. See the paragraph *"7.5 Field Winding Replacement*".

7.3.3 Stator Winding Checks

The stator winding may be checked for opens and shorts with an ohmmeter as follows:

Opens

Connect the ohmmeter leads to two pairs of diode supports as shown in parts "A", "B", and "C" of figure 70. Polarity of the leads must be observed. The ohmmeter should indicate a low resistance. If an infinite or a high resistance is measured in either one or both checks, the stator windings are open.

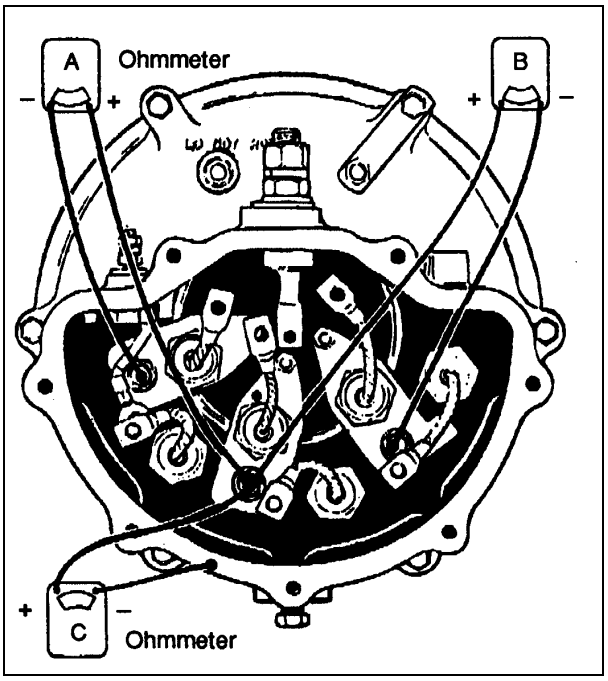


FIGURE 70: STATOR WINDING TEST 06072

Grounds

To check the stator windings for grounds, connect an ohmmeter to the diode support and diode end frame as shown in part "C" of figure 69. The ohmmeter should indicate a very high or infinite resistance. If zero, or a very low resistance is measured, the windings are grounded.

Shorts

The stator windings are difficult to check for shorts without finely calibrated laboratory test equipment due to the very low resistance values of the windings. However, if all other alternator checks are satisfactory, yet the unit fails to perform to specifications, shorted stator windings are likely.

7.4 Diode Replacement

The following replacement procedures are based on the assumption that the diode end cover is still removed and diode leads were disconnected as explained earlier in this section.

***Note:* When replacing a diode, make sure it is designed for a negative ground system. The diode can be identified by the symbol stamped on the diode case. The arrow must point toward the diode flexible lead.**

To replace the three diodes which are mounted in the supports attached to the stator lead studs, it is necessary to remove the diode and support assembly. The two outer diode and support assemblies are identical and can be installed on either side. The center unit has a different support, with 2 inches (50,8 mm) between the mounting hole centers.

***Note:* The outer supports are provided with 2 1/4" (57,15 mm) center holes.**

7.4.1 Diode (in Support) Replacement

1. Remove nut with lock washer attaching the diode support to the stator lead stud.
2. Remove nut, lock washer, and flat washer attaching support to the small stud in the end frame.
3. Remove the diode and support assembly, then remove insert from small hole in support or from small stud in the end frame.
4. Remove nut and flat washer from diode mounting stud, then remove diode from the support.
5. Place a new diode in the support and install a flat washer and nut on the diode mounting stud. Hold the diode with a wrench placed over flats on the diode, while tightening nut on the mounting stud to a torque of 160-180 lbf•in (18-20 N•m).
6. Place diode and support assembly over the stator lead stud and the small mounting stud. Place insert over small stud inside the hole in the support. Install flat washer, lock washer, and nut on the small stud, and tighten to a torque of 22-25 lbf•in (2-3 N•m). Install nut with lock washer on stator lead stud and tighten firmly.

7.4.2 Diode (in End Frame) Replacement

To remove diode, use a thin 1 inch open end wrench on flats of the diode case to unscrew diode from the end frame. Thread the new diode into the end frame and tighten to a torque of 160-180 lbf•in (18-20 N•m). If no other parts are to be replaced, refer to *"Diode end cover installation"* later in this section.

7.5 Field Winding Replacement

7.5.1 Removal

1. Remove three diode and support assemblies from the end frame to provide access to the two lower field to end frame bolts.
2. Remove nut with lock washer and flat washer from three stator lead studs.
3. Remove the six bolts and lock washers attaching the diode end frame to the stator frame.
4. Separate the end frame from the stator frame, and remove the end frame and field assembly from the rotor while pushing the stator lead studs out of the end frame.
5. Remove nut, lock washer, flat washer, and insulating washer which secure the field lead terminal stud in the end frame. Push the stud out of the end frame.
6. Remove field terminal stud insulating bushing and seal from the end frame. Remove insulating sleeve from the field terminal stud.
7. Remove the four bolts and lock washers attaching the field to the end frame.
8. To separate the field from the end frame, install four 3/8-24 x 3 inch bolts in place of the 3/8-24 x 2 inch bolts removed in step 7. Thread bolts in to equal heights. Support the end frame in an arbor press, then using a suitable press plate to exert pressure on all four bolt heads, press the field out of the end frame.

7.5.2 Installation

1. Position the field assembly on the end frame, insert four 3/8-24 x 3 inch bolts through the end frame and thread into the field to keep holes aligned.
2. Support the end frame on an arbor press bed in such a manner that the diodes will not be damaged, and press the field into the end frame. Press in until shoulder on field coil bottoms against the end frame.
3. Remove the four guide bolts. Install four 3/8-24 x 2 inch bolts, using new lock washers to attach the field to the end frame. Tighten bolts securely.
4. Place insulating sleeve in inner side of the field terminal stud hole in the end frame, and insert

the terminal stud through the sleeve. Place two O-rings and insulating bushing over the terminal stud and push into hole in the end frame. Install insulating washer, flat washer, toothed lock washer, and nut on terminal stud and tighten firmly.

5. Install each stator lead stud in the end frame as follows: Place insulating washer over the stud and insert the stud through the end frame. Place the insulating bushing over the stud and position in end frame hole. Install flat washer, lock washer, and nut on the stud, and tighten firmly.
6. Install three diode and support assemblies on the end frame as previously directed under "Diode replacement".
7. Install a new seal in notch around end of the stator frame. Insert field into the rotor and position the end frame against the stator frame. Attach end frame to the stator frame with six bolts and lock washers. Tighten bolts firmly.
8. If no other parts require replacement, refer to "Diode end cover installation" later in this section to complete the assembly.

7.6 Stator Winding Replacement

If tests performed under *paragraph "7.3.3 Stator Winding Checks*" earlier in this section indicated an open circuit or short in the stator, the stator and frame assembly must be replaced.

7.6.1 Removal

1. Remove diode end frame and field assembly as previously directed in steps 1 through 4 under paragraph "7.5.1 R*emoval"* procedure.
2. Remove the six bolts and lock washers attaching the stator frame to the drive end frame.
3. Separate the stator frame from the drive end frame and remove the stator frame from the end frame and rotor.

7.6.2 Soldering Stator Terminal Leads

1. Using a wire brush, thoroughly clean the wire and terminal.
2. Silver solder the stator lead to the terminal using a torch.
3. Thoroughly clean the silver solder connection with a wire brush.
4. Using a high grade energized rosin flux, coat the silver soldered connection with a 80-20 tin-lead solder or pure tin solder to prevent deterioration of the silver solder by engine oil.

Note: ***The silver solder will provide the required mechanical strength which will not be affected by temperature. The tin-lead solder will protect the silver solder connection from deterioration by engine oil.***

7.6.3 Installation

1. Position new seal in notch around the drive end of the stator frame.
2. Position the stator and frame assembly over the rotor against the drive end frame. Attach the stator frame to the drive end frame with six bolts and lock washers. Tighten bolts firmly.
3. Install diode end frame and field assembly as directed in steps 5, 6 and 7 under paragraph *"7.5.2 Installation"* procedure.
4. Install rectifier end cover as directed later.

7.7 Diode End Cover Installation

1. Make sure all diodes are properly installed and securely tightened. Leads from diodes threaded into the end frame must be securely attached to the diode supports. The relay terminal lead must also be attached to the left diode support.
2. Connect leads from the three diodes mounted in supports to the output terminal stud. Tighten the attachment screw firmly. Place insulating bushing over relay terminal stud.
3. Place a new seal in the diode end frame.
4. With the end cover in place against the end frame, install the cap screws (7) and lock washers. Tighten the cap screws evenly and firmly.
5. Make sure the drain plug was installed in bottom of the end cover and was securely tightened.

7.8 Alternator Replacement

7.8.1 Removal

1. Place *"Starter selector switch"* in engine compartment to the *"Off"* position.

2. Place to the *"Off"* position the:

- Main battery disconnect switch (XL-40 coach);
- Toggles switch and the battery master switch (XL-45 coach);

- 12 and 24 volts main battery disconnect switch (XL-40, XL-45E and XL-45 converted vehicles).

3. Remove alternator driving belt (refer to appropriate heading later in this section).

Note: ***When reinstalling drive belt, it is important that the belt tension is correctly set (refer to the appropriate heading later in this section).***

4. Scratch off protective sealer from electrical connections (relay, field and positive terminals). Refer to figure 71.

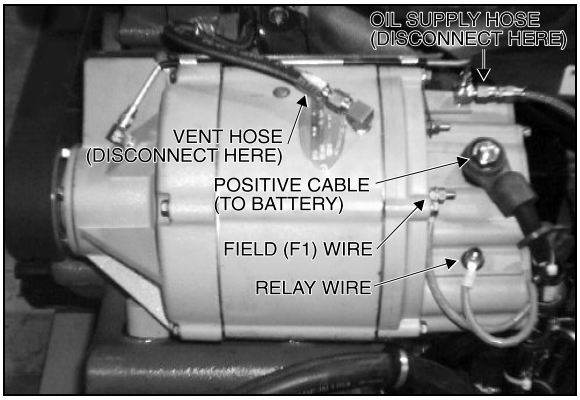


FIGURE 71: ALTERNATOR (HOSES AND WIRES) 06073

Note: ***After connecting electrical wires back, it is important to cover terminals with protective sealant (Prévost part #680745).***

5. Disconnect wires #25 from the relay terminal, #107 from the field "F1" terminal and disconnect battery cable from the positive "+" terminal on the diode end cover. Tag wires removed to ease identification at time of installation. Refer to figure 71.

6. Disconnect oil supply line and vent hose from top of alternator (Fig. 71) and tape lines to prevent admission of foreign matter. Disconnect oil drain hose from bottom of alternator (Fig. 72) and tape line to prevent admission of foreign matter.

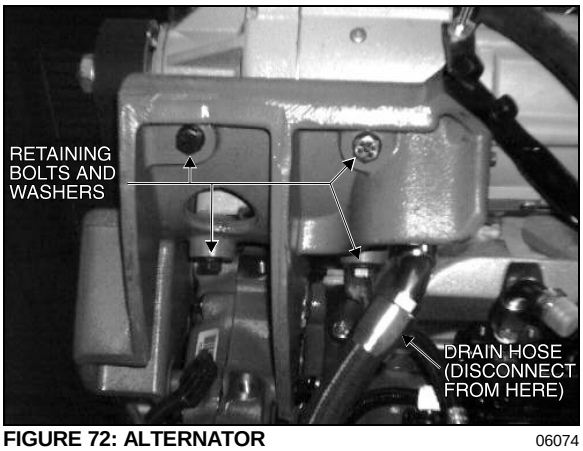


FIGURE 72: ALTERNATOR 06074

7. Remove the four bolts and lock washer retaining alternator (Fig. 72).

Warning: ***Alternator weight is approximately 150 lb. (70 kg), so another person is required to help in taking alternator out of engine compartment.***

8. Take the alternator out of engine compartment.

7.8.2 Disassembly

After diode, field or stator winding checks, the alternator can be disassembled to repair a faulty component, such as field, stator, or to proceed with bearing or rotor replacement. The alternator may be disassembled by following the steps hereafter:

1. Remove nuts and washers from "DC" terminal on diode end frame.
2. Separate the diode cover plate from the diode end frame by removing the mounting screws.
3. Remove the washer, nut and lock washer attaching the diode supports to the end frame, the three screws connecting the diode leads to the diode supports, and the three nuts which attach the stator studs to the diode supports.
4. Separate the diode support assemblies from the diode end frame, and the three nuts which connect the studs to the diode end frame.
5. Mark the position of the drive end frame and diode frame with respect to the stator assembly so that the parts can be reassembled in the same position.
6. Detach the diode end frame and field assembly from the stator assembly by removing the attachment screws.
7. Separate the field assembly from the diode end frame by removing the four attachment screws.
8. Separate the rotor assembly and drive end frame from the stator assembly by removing the attachment screws.
9. Remove the shaft nut and washer, and the pulley. Press the rotor shaft out of the drive end frame.
10. Remove the retainer plate and pull the bearings from the drive end frame.

7.8.3 Alternator Cleaning and Inspection

Whenever the alternator is disassembled, it should be cleaned and inspected as follows:

Cleaning

If sludge has accumulated on the stator, a light mineral oil should be used to clean the stator.

Inspection

When the alternator has been disassembled to a point that the stator is exposed, the stator should be checked for the following:

a) Adequate varnish.

b) Proper spacing of conductors so that "near shorts" do not exist.

c) Proper phase lead placement.

d) Strong conductor and cross-over welds.

7.8.4 Bearing or Rotor Replacement

Whenever the rotor and drive end frame are disassembled for any reason, the single-row ball bearing must be replaced with a new one due to the probability of its being damaged during disassembly.

Removal and Disassembly

1. If the pulley was not removed from the rotor shaft at time of alternator removal, remove the nut and flat washer from the shaft and pull the pulley off the shaft.
2. Remove the six bolts and lock washers attaching the drive end frame to the stator frame. Separate the drive end frame from the stator frame, then remove the drive end frame and support assembly.
3. Support the drive end frame in an arbor press in such a manner that the rotor can be pressed down out of the end frame. Using a suitable adapter against the end of the rotor shaft which will pass through the inner race of the double-row ball bearing, press the rotor down out of the end frame and bearings. Since the single-row bearing outer race is held in the end frame by the retainer plate, and the inner race is a press fit on the rotor shaft, the bearing is likely to be damaged when the shaft is pressed out and must be replaced with a new part.
4. Remove the six screws attaching the bearing retainer plate to the drive end frame. Remove the retainer plate, the single-row bearing and the bearing spacer from the end frame.
5. Support the drive end frame in an arbor press with the double-row bearing down, in such a manner that the bearing can be pressed down out of the end frame. Using a suitable driver which will exert a force on the bearing outer race, press the bearing out of the end frame.
6. Remove the rubber bearing clamp from groove in the end frame.

Assembly and Installation

1. Install a new single-row ball bearing into inner side of the drive end frame. Install the bearing retainer plate and attach with six screws. Stake screws in place after tightening.
2. Position the rubber bearing clamp in groove in bearing bore of the drive end frame. Lubricate the clamp to permit the bearing to be pressed in without dislodging or damaging the clamp.
3. Position the rotor in an arbor press with the shaft end up. Install the drive end frame and single-row bearing assembly over the rotor shaft. Using a driver over the rotor shaft which will exert a force on the bearing inner race, press the bearing onto the shaft until it bottoms against the rotor.
4. Install bearing spacer over the rotor shaft. Position the double-row bearing over the rotor shaft at end frame bore. Using an adapter which will exert a force on both the inner and outer races of the bearing, press the bearing onto the shaft and into the end frame until the inner race bottoms against the bearing spacer.
5. Place a new seal around the drive end of the stator frame.
6. Insert the rotor between the stator and field, and position the drive end frame against the stator frame. Attach the end frame to the stator frame with six bolts and lock washers. Tighten the bolts to a torque of 5 to 5.4 lbf•ft (6-7 N•m).

Caution: ***When replacing the alternator on vehicle, ensure that an alternator with the proper drive ratio is used. Installation of an alternator with any other drive ratio will result in severe and costly damage to the alternator and engine.***

7.8.5 Reassembly

Reassembly is the reverse of disassembly.

Note: ***When tightening the outside nut on the "DC" output terminal, torque the nut to 30-35 lbf•ft (41-47 N•m). The lower nut should be supported while tightening the top nut.***

When reinstalling diodes, tighten to a torque of 9-11 lbf• ft (12-15 N•m).

7.8.6 Output check

When removed from the engine, the alternator may be checked on a test bench without circulating oil, providing the output is limited to 100 amperes or less. The alternator may be bench tested without circulating oil at outputs exceeding 100 amperes, as

long as the period of operation is limited to less than 15 seconds.

Caution: ***Operating the alternator at outputs greater than 100 amperes for periods exceeding 15 seconds without adequate oil circulation, will cause the alternator to overheat, resulting in damage to the winding and diodes.***

If the alternator is to be operated at an output greater than 100 amperes for longer than 15 seconds, circulating oil must be provided. SAE 30 engine oil must be supplied to the connection on the diode end cover at a pressure of 35 psi and at a temperature of 60 °F to 220 °F (16 °C to 104 °C). This will provide an oil flow of about one gallon per minute.

To check the alternator on a test bench, make electrical connections as shown in figure 66. Be sure to connect the negative battery terminal to the alternator frame.

7.9 Alternator Drive Belt

7.9.1 Removal and Installation

Removal

1. Loosen the two bolts retaining the tensioning arm (Fig. 73).

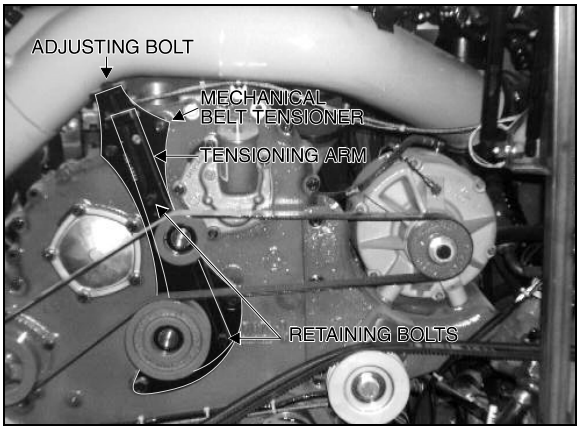


FIGURE 73: ALTERNATOR DRIVE BELT 06075

2. Unscrew the adjusting bolt to slacken belt.
3. Remove belt.

Installation

Reverse removal procedure to reinstall alternator drive belt.

Note: ***After belt installation, it is important to tension belt as per paragraph "7.9.2 Adjustment".***

7.9.2 Adjustment

Periodic retensioning on the belt is required to maximize belt life. The belt tension should be measured every 6.250 miles (10 000 km) or twice a year, whichever comes first. The following procedure describes proper tensioning practices.

Note: ***Steps 1 and 2 should only be performed on new belts.***

1. Loosen the two bolts retaining tensioning arm, then use the adjusting bolt to tension belt to 300 pounds.

Note: ***A belt tension gauge (Prévost kit #011742) is available and is supplied with an instruction sheet. Refer to its procedure to use belt tension gauge correctly.***

2. Run engine for 10 minutes, and allow the belt to cool 10-15 minutes.
3. Measure the belt tension. If tension on the belt is greater or equal to 200 pounds, no retensioning is required. If tension on the belt is less than 200 pounds, retension the belt to 200 pounds.

7.10 Alternator (24 Volts-75 Amps)

This alternator is located in the engine rear compartment, on the starter side of engine (Fig. 74).

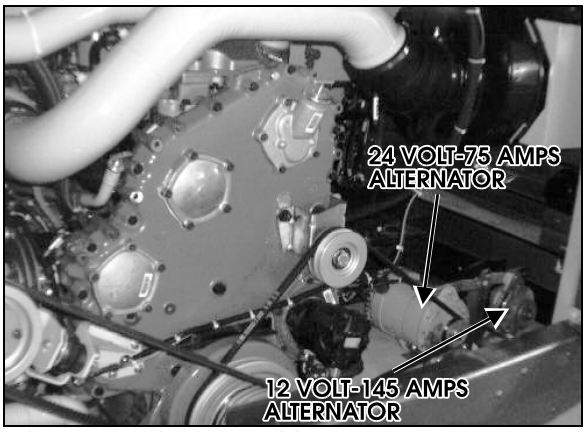


FIGURE 74: ENGINE REAR COMPARTMENT (ALTERNATOR) 06140

The alternator bearings are permanently lubricated. There are no external provisions for alternator bearing lubrication.

7.10.1 Alternator Wiring Test

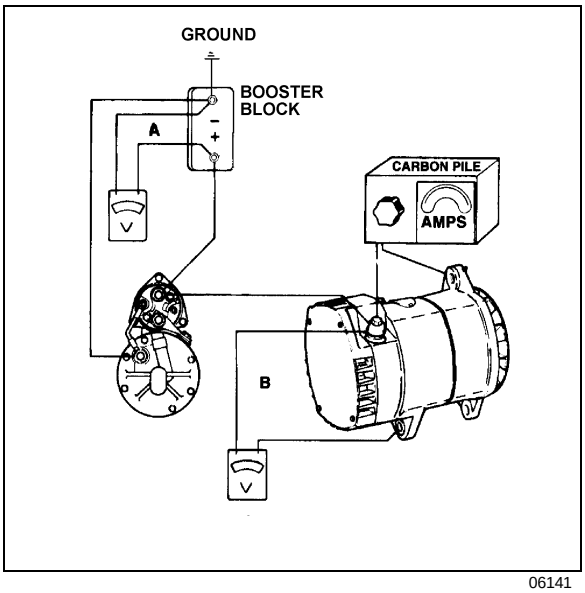
The output of the alternator must reach the batteries and accessory loads with a minimum amount of voltage loss. Any loss slows the rate of charge to the batteries and could cause the batteries to be in some state of discharge. This voltage loss can appear to the technician as a faulty alternator or voltage regulator.

Before a suspected bad alternator or regulator is replaced or removed for service, the cables and connections between the alternator and the storage batteries should be checked for high resistance as follows:

7.10.2 Charging Circuit Voltage Drop Test

Before the charging circuit voltage drop test is performed, the batteries should be load-tested to ensure they are suitable for service. Refer to the appropriate battery manufacturer's service instruction for load test information. Replace any batteries that fail a load test. All battery terminals should be cleaned and tightened. Then proceed as follows:

1. With the engine NOT running, connect a carbon pile to the alternator output terminal and the alternator housing as shown in Figure 75.



06141

FIGURE 75: CHARGING CIRCUIT VOLTAGE DROP TEST

Note: ***Use care when connecting the carbon pile to the alternator output terminal, not to allow the pile clamp to touch ground. The output terminal is at battery voltage.***

2. Connect a voltmeter across one of the batteries, red lead to positive and black lead to negative as shown at "A" in Figure 75.
3. With the engine NOT running, turn the knob of the carbon pile until the gage on the carbon pile reads the alternator rated output in amps.

Note: ***The alternator's rated output is typically stamped on the alternator housing or on a name tag located on the alternator housing.***

4. Read and record the battery voltage. Turn the carbon pile off.
5. Move the voltmeter to the alternator. Connect the red voltmeter lead to the alternator output terminal and the black voltmeter lead to the alternator housing as shown at "B" in Figure 75.

Note: ***Do not connect the voltmeter leads to the carbon pile leads.***

6. Turn the carbon pile knob until the meter again reads alternator rated output in amps.
7. Read and record the voltage at the alternator. Turn the carbon pile off.

8. Subtract the voltage reading recorded at the alternator from the voltage reading obtained at the battery.

   VOLTAGE READING AT BATT.

   - VOLTAGE READING AT ALT.

   = TOTAL VOLTAGE DROP

9. The result is measure of the charging circuit voltage drop. Maximum allowable charging circuit voltage drop is 0.5 volts for a 12-volt system (1.0 volts for a 24-volt system).

10. If the voltage drop reading was below specification, the system is satisfactory. Go to the ALTERNATOR OUTPUT TEST. If the reading was more than allowed it will be necessary to determine if the voltage drop is located in the positive or negative side of the charging circuit. Go the next step.

11. With the carbon pile still connected, connect a low scale voltmeter (digital preferred) as shown in Figure 76.

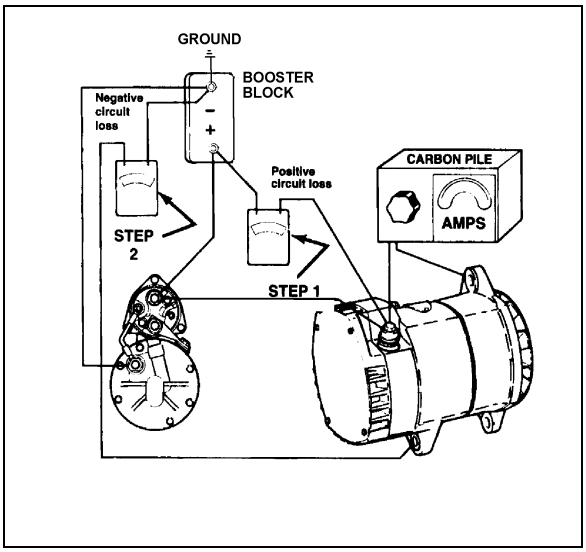


FIGURE 76: CHARGING CIRCUIT VOLTAGE DROP TEST
06142

12. Connect the red lead of the voltmeter to a battery positive terminal. Connect the black voltmeter lead to the alternator output terminal as shown in Step 1, Figure 76 (you may need a jumper wire to extend your voltmeter leads).

13. Turn the carbon pile knob until the gage on the carbon pile reads the alternator rated output in amps.

14. Read and record the voltmeter reading. Turn the carbon pile off.

15. Connect the voltmeter leads to the negative side of the charging circuit as shown in step 2, Figure 76.

16. Connect the red voltmeter lead to the alternator housing and the black voltmeter lead to the battery negative terminal.

17. Turn the carbon pile knob until the gage on the carbon pile reads the alternator rated output in amps.

18. Read and record the voltmeter reading. Turn the carbon pile off.

19. POSITIVE CIRCUIT LOSS

    - NEGATIVE CIRCUIT LOSS

    = TOTAL SYSTEM LOSS

    12-volt system-0.5 volts maximum

    24-volt system-1.0 volts maximum

20. The above procedure should show which circuit has the excessive voltage loss. Remove the carbon pile and voltmeter. Repair or replace the problem portion of the circuit.

7.10.3 Alternator Output Test

Tighten both the alternator mounting bolts (adjusting rod and pivot point) and be sure all the charging circuit cables and connections are clean and tight. Then test the alternator output as follows:

1. The engine must be at shop temperature. Connect a charging-starting system analyzer, with a voltmeter and ammeter, to the vehicle. Connect the voltmeter leads to one of the batteries, observing proper polarity. If the analyzer has an inductive pickup, place it around the alternator output wire (Fig. 77).

2. If the charging-starting system analyzer does not have a carbon pile, connect a carbon pile across one of the batteries.

Note: ***On 24-volt vehicles, connect the carbon pile across one 12-volt battery. Connect the voltmeter across the normal 24-volt battery connection.***

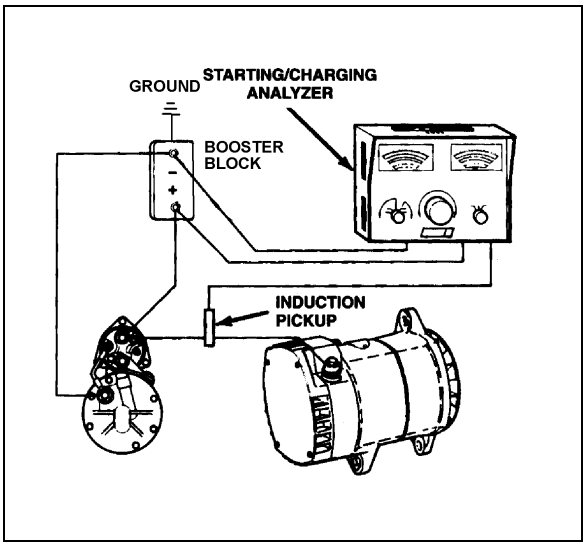


FIGURE 77: ALTERNATOR OUTPUT TEST 06143

3. With NO electrical loads turned on, start the engine and accelerate to a fast idle. Observe the voltmeter. When the voltage stabilizes (does not increase) for two minutes, read and record the voltage. Voltage should not exceed 15 volts (30 volts for a 24-volt system). If the voltage exceeds the maximum allowable by one volt, the voltage regulator is defective. Remove the alternator for repair.
4. If the voltage was acceptable, accelerate the engine to approximately 1800 rpm and turn the carbon pile knob until the ammeter shows the output has reached the highest value. Record this reading (amps).Turn off the carbon pile. Allow the engine to idle down for at least 30 seconds. Turn off the engine.
5. The alternator rated output is stamped on the alternator case or on a name tag on the alternator housing. Compare the reading obtained in step 4 above, to the alternator's rated output. If the current measured is not within 10% of the rated output, remove the alternator for repair.

7.11 Alternator (12 & 24 Volts) Removal and Installation

7.11.1 Removal

It doesn't matter what type of installation and alternators are installed (12V-145 AMPS & 24V-75 AMPS) on vehicle, the removal and installation are the same.

See typical installation in the following figures:

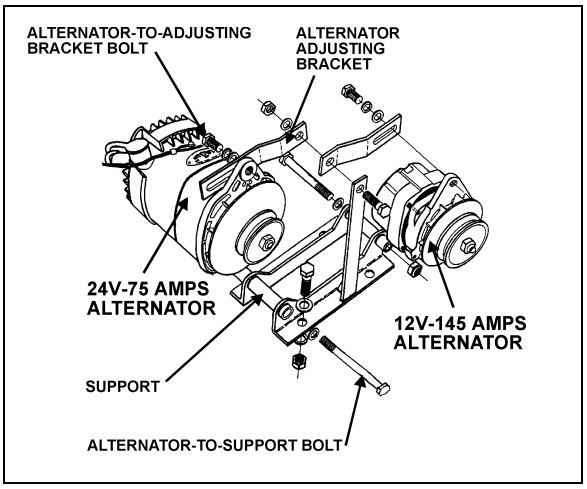


FIGURE 78: 12V-145 AMPS AND 24V-75 AMPS ALTERNATORS 06144

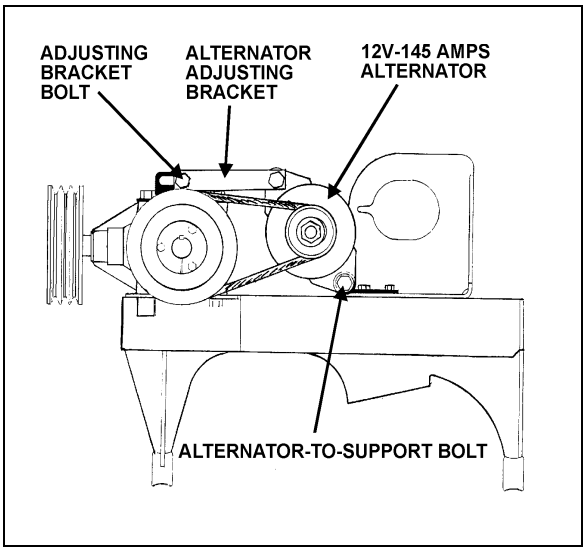


FIGURE 79: FAN CLUTCH SUPPORT 06145

Caution: ***Never attempt to service the engine electrical system until the batteries have been disconnected.***

1. Disconnect the cables at the batteries. If the alternator has more than the output cable lead, disconnect all other leads from the alternator and tag each one to ensure correct reinstallation. Remove the alternator output cable.
2. Loosen the alternator-to-adjusting bracket bolt to allow slack in the belt. Remove the belt.
3. While supporting the alternator, remove the alternator-to-adjusting bracket bolt and washer(s).
4. Loosen and remove the nut and washer at the rear alternator mounting flange. Remove the alternator-to-support bolt while supporting the alternator to prevent it from falling.
5. Remove the alternator carefully to prevent costly physical damage.
6. Remove and retain the alternator pulley lock nut, alternator pulley and locknut, alternator pulley and fan from the unit if it is to be replaced.

7.11.2 Alternator Service

Repair and overhaul work on alternators should be referred to an authorized repair station of the manufacturer of the alternator. Replacement parts for alternators should be ordered through the equipment manufacturer's outlets. For alternators manufactured by Delco-Remy Division, repair service and parts are available through AC Delco branches and repair stations.

7.11.3 Alternator Installation

Note: ***Check the pulley retaining nut to 70-80 lbf•ft (95-108 N•m) torque.***

1. Position the alternator on the support and align the holes in the alternator mounting flanges with the tube in the support.

Note: ***There are two holes in the front alternator end frame flanges. One is threaded and one is plain. The threaded hole is positioned up and is used to secure the alternator to the adjusting rod.***

2. Install the alternator-to-support bolt and lock nut. Insert the alternator-to-adjusting bracket bolt with washer installed through the alternator adjusting bracket and into the threaded hole in the alternator end frame. Tighten both bolts finger tight.
3. Install the drive belt in the groove of the alternator drive pulley.
4. Adjust the alternator belt tension to 45-55 lbf•ft (61-75N•m). Tighten the alternator-to-support bolt and nut and the alternator-to-adjusting bracket bolt to 60-70 lbf•ft (81-95 N•m) torque.
5. Attach the wires and cables to the alternator. Be sure that each one is correctly installed to the location it was removed from. Keep all connection clean and tight.

New standard V-belt will stretch after the first few hours of operation. Run the engine for 10 to 15 minutes at approximately 1200 rpm to seat the belts, then allow the engine to idle for at least 30 seconds before stopping the engine. Recheck the alternator belt tension and adjust if necessary after 15 miles and again after 250 miles (420 km) of operation. Thereafter, check the tension of the drive belts every 6,250 miles (10 000 km) or twice a year, whichever comes first and adjust, if necessary. Belt should be neither too tight nor too loose. Belt that are too tight impose excess loads on the crankshaft, alternator bearings, shortening both belt and bearing life. Excessively overtightened belt can result in crankshaft breakage. A loose belt will slip and may cause damage to accessory components. If a belt tension gage is not available, adjust the belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt 0.500-0.750 inch (12.70-19.05 mm).

Note: ***When installing or adjusting the drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot.***

Note: ***Drive belts (V and Poly) should be replaced every 100,000 miles (160 000 km).***

8. VOLTAGE REGULATOR

Refer to paragraph "*4. Electrical Compartments*" in this section, for the 24 volt regulator location.

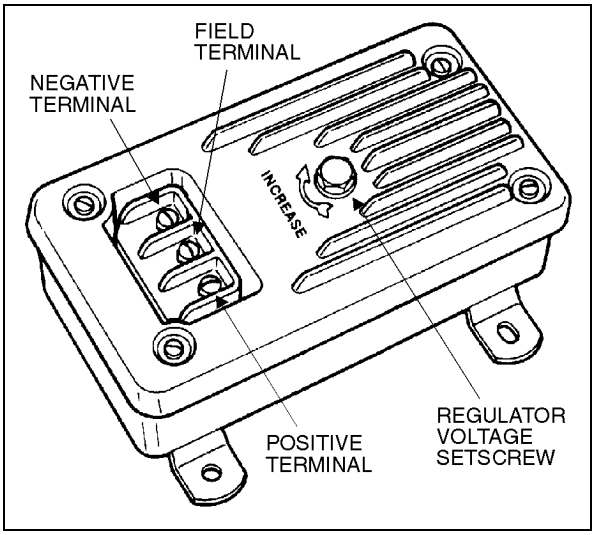


FIGURE 80: VOLTAGE REGULATOR 06076

8.1 Description

The transistor regulator illustrated in figure 80 is an assembly consisting mainly of diodes, capacitors, resistors and transistors. These components are mounted on a printed circuit panel board to form a completely static unit containing no moving parts. Regulators of this type have only **three** terminals which are identified "NEG." (ground), "FLD" (field) and "POS." (battery).

The regulator components work together to limit the alternator voltage to the preset value by controlling the alternator field current. This is the only function that the regulator performs in the charging system.

The voltage at which the alternator operates is determined by the regulator adjustment. Once adjusted, the alternator voltage remains constant, since the regulator is unaffected by length of service, changes in temperature, or changes in alternator output and speed.

A typical wiring diagram of a negative ground system is illustrated in figure 81. This diagram shows only the basic charging system components, and does not show any components such as the control relays. Refer to *"Charging system"* wiring diagram, page 4 in *"Wiring diagrams"* for the electric circuits and connections.

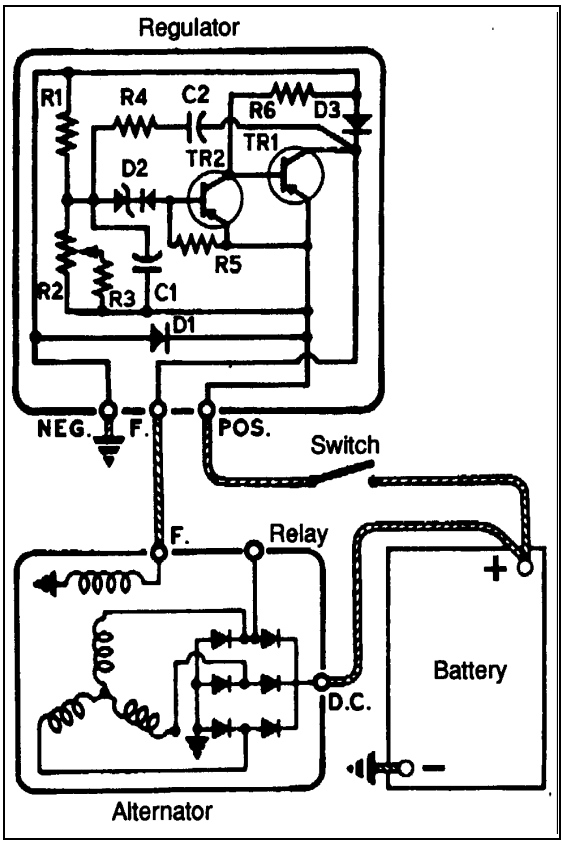


FIGURE 81: TYPICAL WIRING DIAGRAM OF NEGATIVE GROUND SYSTEM 0 6077

8.2 Troubleshooting Procedures

Trouble in the electrical system will usually be indicated by one of these two conditions: an undercharged or an overcharged battery. Either condition can result from an improper voltage regulator setting.

The absence of gassing at the continuous appearance of the green dot in the battery built-in hydrometer indicates that the voltage setting is satisfactory.

8.3 Checking Regulator Voltage Setting

1. To check the voltage setting, connect a voltmeter across the "POS." and "NEG." terminals on the regulator, and an ammeter to the "DC" terminal on the alternator. Refer to figure 82.

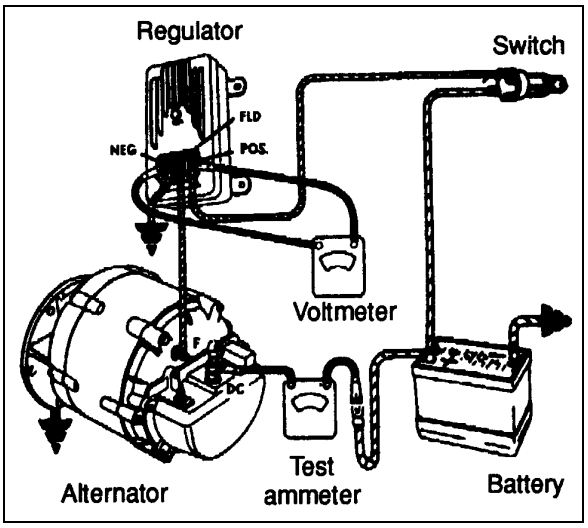


FIGURE 82: REGULATOR VOLTAGE TEST 06078

2. Operate the engine at approximately 1000 rpm (about 2300 alternator rpm) with accessories turned on to obtain an alternator output of 20-200 amperes.
3. Note the voltage setting; it should be steady at 27.5 volts.
4. If not, the desired setting can be obtained by removing the plug from the voltage regulator cover and turning lightly the adjusting screw inside the regulator; clockwise to increase or counterclockwise to decrease the voltage setting. See figure 83 for details.

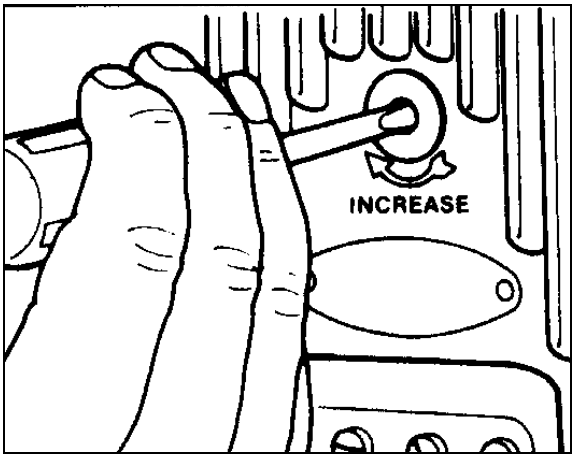


FIGURE 83: REGULATOR VOLTAGE ADJUSTMENT 06079

***Note:* If regulator voltage cannot be adjusted to the specified setting, remove the regulator, repair and/or replace it.**

8.3.1 Undercharged Battery

If the voltage setting as checked above is steady and reasonably close to the specified value and the battery is undercharged, raise the setting by 0.3 volt, then check for an improved battery condition over a minimum service period of 48 hours. If the voltage cannot be adjusted to the desired value, the alternator should be checked as follows:

1. Stop alternator, turn off all accessories and disconnect battery ground cable.
2. Disconnect all leads from the regulator and from the alternator field. **Do not allow leads to touch ground**.
3. Connect a voltmeter and an ammeter in the circuit at the alternator "DC" terminal.
4. Connect a jumper lead from the alternator "DC" terminal to the alternator field terminal.
5. Connect a carbon pile resistor load across the battery. Turn to the *"Off"* position.
6. See figure 84 for wiring connections.

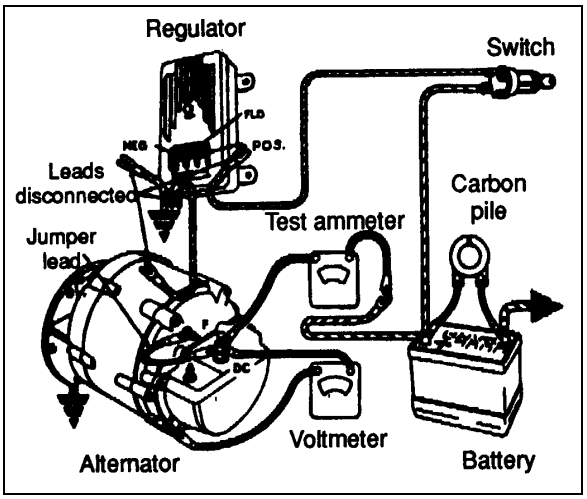


FIGURE 84: REGULATOR VOLTAGE TEST (UNDERCHARGED BATTERY) 06080

7. Reconnect battery ground cable.
8. Turn on all vehicle accessories.
9. Operate alternator and adjust carbon pile resistor load as required to check for rated output as given in Delco-Remy Service Bulletin 1G-187 or 1G-188.
10. Check the alternator field winding as follows:

Disconnect the lead from the field terminal and connect an ohmmeter from the field terminal to ground. A resistance reading above normal indicates an open, and a resistance reading less than normal indicates a short or ground. The normal resistance can be calculated by dividing the voltage by the field current published in Delco-Remy Service Bulletin 1G-186, 1G-187, or 1G-188. The normal resistance value should be at or near midscale on the ohmmeter for accuracy. An alternate method of checking is to connect a battery of specified voltage and an ammeter in series with the field winding, and compare readings with published specifications in Delco-Remy Service Bulletin 1G-186, 1G-187, or 1G-188. An alternator is defective if it does not produce rated output or if field windings are faulty. If the alternator provides rated output, and field windings check satisfactorily, the regulator should be checked as covered under paragraph *"8.4 Regulator Checks"*.

8.3.2 Overcharged Battery

If the voltage setting as checked above is steady and reasonably close to the specified value, lower the setting by 0.3 volt and check for an improved battery condition over a minimum service period of 48 hours. If the voltage cannot be adjusted to the desired value, proceed as follows: where the alternator field is grounded internally in the alternator as shown in figure 81, a shorted or grounded field or a defective regulator can cause an overcharged battery. The field winding can be checked as covered in *"Undercharged battery"* section. If the field winding is found not to be defective, the alternator is not defective, and the regulator should be checked as covered under paragraph *"8.4 Regulator Checks"*.

8.4 Regulator Checks

Separate the cover from the base, and then remove the panel assembly from the cover. Carefully note the location of all washers and lock washers.

The component parts are keyed to figure 81. Before making electrical checks, visually inspect the components and make sure all soldered connections are secure. Various electrical checks with an ohmmeter can be made to determine which components are defective.

The ohmmeter **must** be accurate, and should be a scale-type meter with a 1.5 or 3 volt cell. Most digital ohmmeters can not be used to check semiconductors; however, some digital ohmmeters are specially designed to test semiconductors and can be used to test components in the regulator. Consult the ohmmeter manufacturer concerning the capabilities of his meter.

It is important that all of the following checks be made. If a defective part is found, replace it before proceeding with the remaining checks. Be sure to make all the checks as more than one component may be defective.

A defective regulator can be repaired according to the following methods:

A) By changing the printed circuit board into the regulator. Unscrew the retaining screws on printed circuit and remove it. Then, install a new printed circuit board. This method is the most commonly used.

B) By removing any retaining screws involved and unsoldering the connections. When resoldering, limit solder time to a minimum as excessive heat may damage the printed circuit and component parts. However, good soldered connections are essential for satisfactory operation. A resin core 63% tin 37% lead solder with a 360 °F (182 °C) melting point is recommended along with a soldering iron rated at 50 watts or less. Use extreme care to avoid overheating. Before checking the printed circuit board, remove transistor TR1, which must be checked separately. Connect the ohmmeter as shown in figure 85, and then reverse the ohmmeter leads to obtain two readings on the same component. Use the middle scale on scale-type meters where the 300 ohms value should be within, or nearly within, the middle third of scale.

Capacitors C1 and C2 = The ohmmeter should read high and low on each capacitor. If not, replace capacitor.

Diodes D1, D2, and D3 = Each diode should give one high and one low reading. If not, replace diode.

Resistor R2 = Turn voltage adjustment screw (identified in figure 83) with ohmmeter connecting each way. Reading should change as slotted screw is turned. If not, replace R2.

Transistor TR1 = See figure 85. Use the low scale. Each of the three checks should read low and high. If not replace TR1.

Transistor TR2 = Change the ohmmeter to use the low scale. Check EB should read low and high. Check BC should read low and high. Check EC should both read high. If not replace TR2. See figure 86.

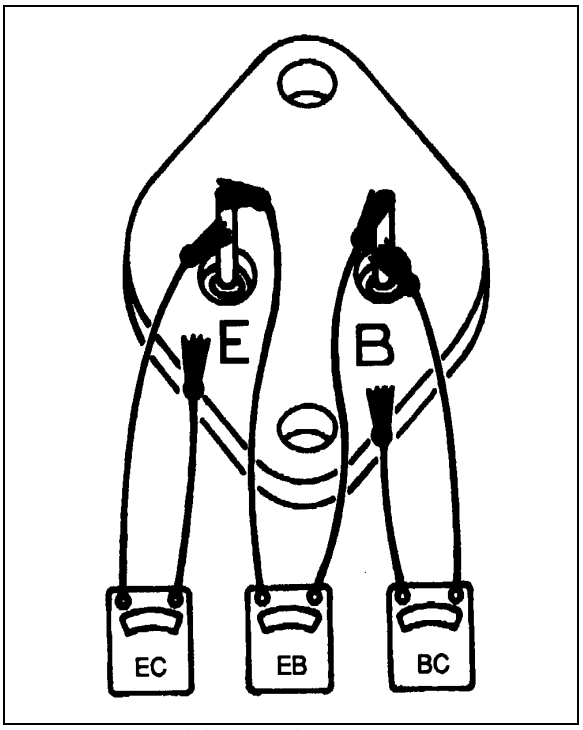


FIGURE 85: TRANSISTOR TEST 06081

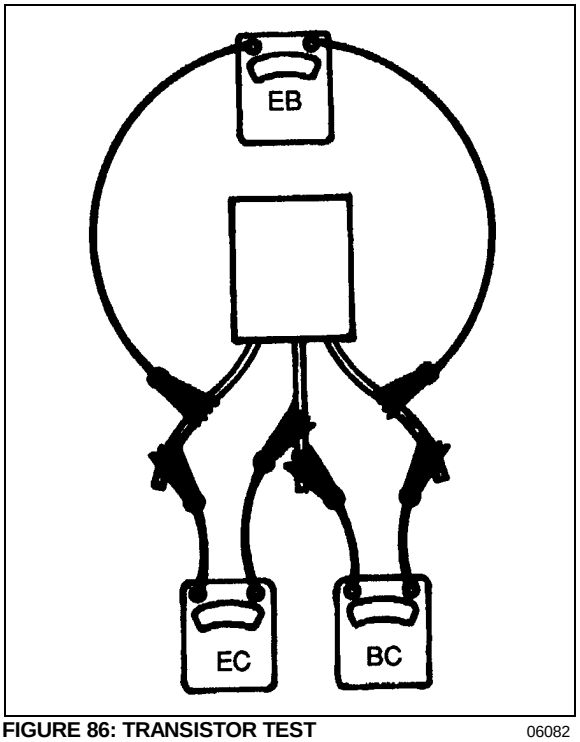


FIGURE 86: TRANSISTOR TEST 06082

8.5 Adjusting Voltage

After repair, the regulator must be adjusted to the desired voltage setting. Follow the procedure under previous paragraph *"8.3 Checking Regulator Voltage Setting"*. Turn **slowly** the adjusting screw full range and observe the voltmeter to insure that the voltage is being controlled, then adjust, **always slowly,** to the desired setting.

9. BATTERY EQUALIZER

Troubleshooting guide and owner manual on the battery equalizer are annexed at the end of this section.

Refer to paragraph "4. Electrical Compartments" of this section, for location.

10. STARTING MOTOR

10.1 Description

The cranking motor is bolted to the flywheel housing as illustrated in figure 87.

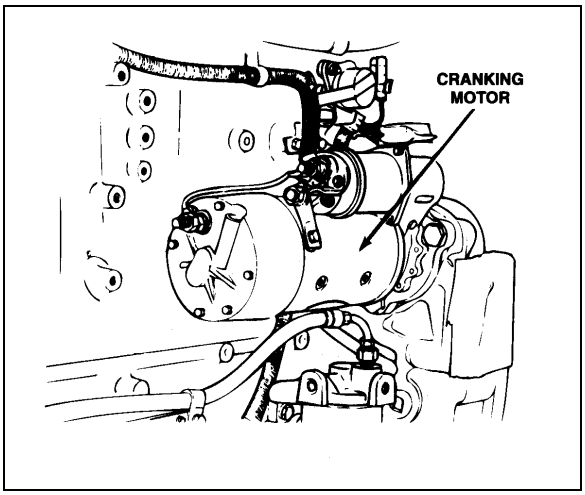


FIGURE 87: CRANKING MOTOR MOUNTING 06146

The starting motor has the shift lever and solenoid plunger that are totally enclosed to protect them from exposure to dirt, icing conditions and splash.

Positive lubrication is provided to the bronze bushing located in the commutator end frame, in the lever housing and in the nose housing, by an oil-saturated wick that projects through each bushing and contacts the armature shaft.

The clutch is a *"Positork"* drive type, moved into mesh with the ring gear by the action of the solenoid. Once engaged, the clutch will not disengage during intermittent engine firing, which prevents damage to pinion and ring gear teeth. The pinion remains engaged until starting is assured and the solenoid circuit is interrupted. Refer to figure 88 for more details.

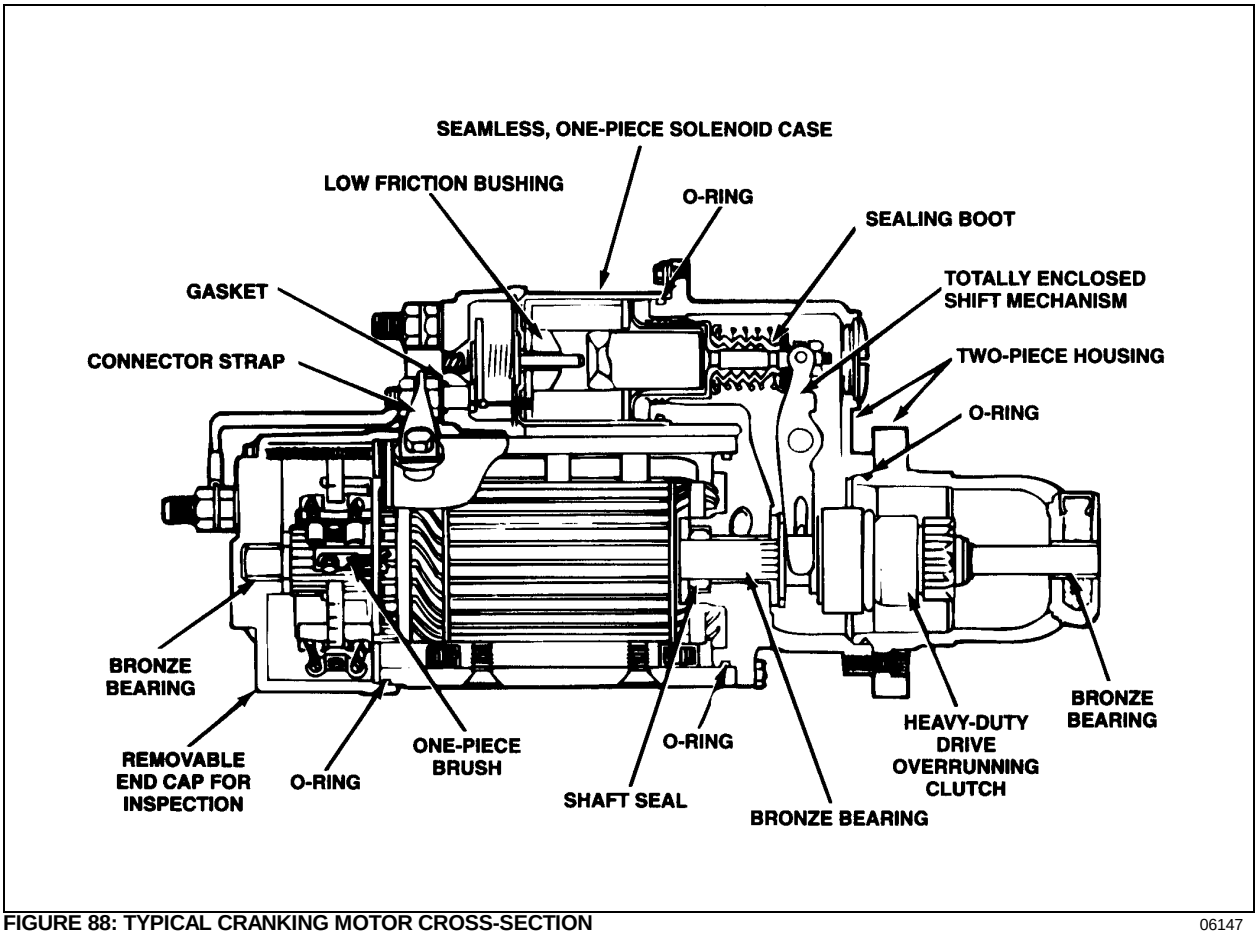


FIGURE 88: TYPICAL CRANKING MOTOR CROSS-SECTION 06147

10.2 Maintenance

All wicks and oil reservoirs should be saturated with SAE 10 oil, and the splines underneath the clutch should be lubricated with a light coating of SAE 10 oil. Other than normal periodic lubrication and keeping cable connections clean and tight, the starting motor should require no periodic maintenance. However, under normal operating conditions, the starting motor should be disassembled, inspected, cleaned and tested at time of engine overhaul.

10.3 Cranking Motor Replacement Determination

Failure of the cranking motor to crank the engine at normal cranking speed may be due to a defective battery, worn battery cables, poor connections in the cranking circuit, defective engine starting switch, low temperature, condition of the engine or a defective cranking motor.

To determine if the cranking motor is the problem, it will first be necessary to check the batteries, the cranking circuit, the magnetic switch, the solenoid and the control switch. If the batteries pass a load test, and a visual inspection of the cranking circuit does not reveal an obvious problem, use the following guidelines.

Circuit using a magnetic switch can also fail to ”hold in” during cold weather cranking and low voltage even though the switches and circuit test OK. This will sound as though the cranking motor is failing to stay engaged. It is caused by the low voltage of the system releasing the electrical connection of the magnetic switch.

If this condition exists, have an assistant clamp a heavy battery jumper cable between the two large studs of the magnetic switch while cranking.

Caution:* *The magnetic switch studs are at battery voltage and the engine should crank when the jumper is connected.

Remove the jumper to stop cranking. If the engine cranks normally with this jumper in place, replace the magnetic switch.

If the batteries, switches, and wiring have been checked and the cranking motor still cranks slowly, check for available voltage at the cranking motor solenoid while cranking (Fig. 89).

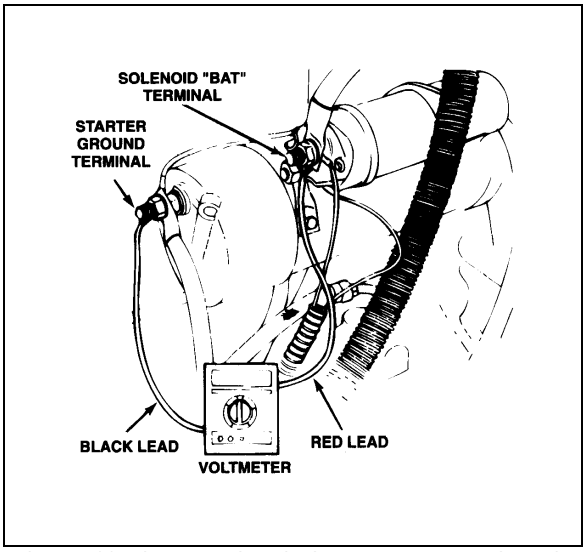


FIGURE 89: CRANKING MOTOR AVAILABLE VOLTAGE TEST 06148

Place the red lead of a voltmeter to the solenoid "BAT" terminal, and the black voltmeter lead to the starter ground terminal as shown in figure 89. Engage the starter switch and read the voltage on the meter. If the voltage is 9.0 volts or less while cranking (18.0 volts if it is a 24-volt system) at room temperature, check the interconnecting cables between batteries.

To check the interconnecting battery cables, quickly measure the terminal voltage of each battery **while cranking.** Touch voltmeter leads to the post or stud nut of each battery. If the difference between any two battery readings is more than 0.5 volt, or any cable or connection feels warm to the touch, check or replace the interconnecting cable.

If, after making all of the checks described above, the vehicle still does not crank properly, there is either an internal engine problem, or the cranking motor should be removed for repair.

Caution: ***Never operate the starting motor more than 30 seconds at a time without pausing to allow it to cool for at least 2 minutes. Overheating, caused by excessive starting, will seriously damage the starter.***

10.4 Removal

Caution: ***Never attempt to service engine electrical systems (except DDEC) until the batteries have been disconnected.***

Normally, the starting motor should be removed and disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor.

1. Remove the ground strap or negative cable(s) from the battery(s).
2. Disconnect the cranking motor cables and solenoid wiring.
3. Support the motor and remove the three bolts which secure it to the flywheel housing. Pull the motor out to remove it from flywheel housing.

Note: ***Tag each lead to ensure correct connections when the cranking motor is reinstalled.***

10.5 Cleaning

The driving mechanism armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricants in the drive mechanism and damage the insulation in the armature and field coils. All parts, except the drive, should be cleaned with mineral spirits and a brush. The drive can be wiped with a clean cloth.

If the commutator is dirty, it may be cleaned with No. 00 sandpaper.

Caution: ***Never use emery cloth to clean commutator.***

10.6 Armature Servicing

If the armature commutator is worn, dirty, out of round, or has high insulation, the armature should be put in a lathe so the commutator can be turned down. The insulation should then be cut 1/32" (0,79 mm) wide and 1/32" (0,79 mm) deep, and the slots cleaned out to remove any trace of dirt or copper dust. As a final step in this procedure, the commutators should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedures.

The armature should be checked for opens, short circuits and grounds as follows:

Opens Circuit Test

Opens are usually caused by excessively long starting periods. The most likely place for an open to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the com-

mutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the starting motor is used. If the bars are not too badly burned, repair can often be performed by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material. The insulation should then be undercut.

Caution: ***Do not undercut the insulation between the commutator segments after turning down the commutator.***

Short Circuit Test

Short circuits in the armature are located by means of a growler. When the armature is revolved in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

Ground Test

Grounds in the armature can be detected by the use of a 110 volts test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure, which is often brought about by overheating of the starting motor produced by excessively long starting periods, or by accumulation of brush dust between the commutator bars and the steel commutator ring.

10.7 Field Coil Checks

The field coils may be checked for grounds and opens by using a test lamp.

Grounds

If the motor has one or more coils normally connected to ground, the ground connections must be disconnected during this check. Connect one lead of the 110 volts test lamp to the field frame and the other lead to the field connector. If the lamp lights, at least one field coil is grounded, and it must be repaired or replaced.

Opens

Connect test lamp leads to ends of field coils. If lamp does not light, the field coils are open.

10.8 Field Coil Removal

Field coils can be removed from the field frame assembly by using a pole shoe screwdriver. A pole shoe spreader should also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoe is tightened into place. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip should be assembled in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

10.9 Nose Housing Relocation

The nose housing on the sprag clutch-type cranking motor on some starters can be rotated to obtain a number of different solenoid positions with respect to the mounting flange. When repositioning of the solenoid is required on service replacement cranking motor, proceed as follows:

The nose housing is attached to the lever housing by six bolts located around the outside of the housing. Relocate the nose housing as follows:

1. Remove the six socket head screws (1 short and 5 long) and six neoprene plugs from the unused holes if a twelve-hole mounting flange is used.
2. Turn the nose housing to the required position.
3. Install the six socket head screws, with the short screw in the shallow hole nearest the solenoid, and six neoprene plugs, if a twelve hole mounting flange is used.
4. Tighten the screws to 13-17 lbf•ft (18-23 N•m) torque.

Note: ***Solenoid should not be located below the centerline of the cranking motor or dust, oil, moisture and foreign material can collect and cause solenoid failure.***

10.10 Installation

To install the cranking motor, reverse the procedure outlined for removal. Tighten the cranking motor attaching bolts to 138-154 lbf•ft (187-209 N•m) torque.

Keep all of the electrical connections clean and tight. Install wiring terminal leads to the cranking motor and the solenoid switch, tighten the smaller connections to 16-30 lbf•in (1.8-3.4 N•m) torque and the larger connections to 20-25 lbf•ft (27-34 N•m) torque.

***Note**: If a cast iron flywheel housing is used, the cranking motor attaching bolts should be tightened to 181-226 lbf•ft (245-306 N•m) torque*

10.11 Pinion Clearance

Pinion clearance should be checked after reassembly of motor to ensure the clearance is within specifications. To check pinion clearance (starting motor off engine), first disconnect the motor field connector from the solenoid motor terminal. Connect 24 volt battery with the positive battery lead to the solenoid switch terminal (5), and the negative battery lead to the grounded (G) solenoid terminal. Momentarily flash a jumper lead from the solenoid motor terminal to the grounded (G) solenoid terminal. The pinion gear will now shift into cranking position and remain so until the battery is disconnected. Push the pinion or drive back towards the commutator end to eliminate slack movement. Measure the distance between pinion and pinion stop. This should be 23/64" ± 1/32" (9,5 mm ± 0,79 mm). Pinion clearance is adjusted to these limits by turning the solenoid shaft nut after removing access plug in shift housing. See figure 90.

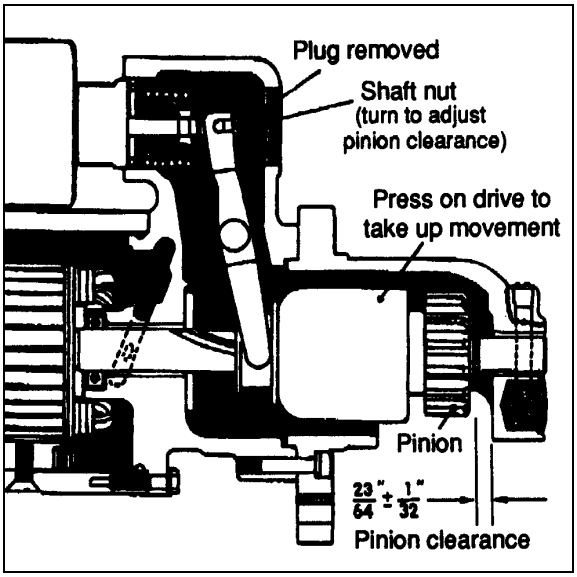


FIGURE 90: PINION CLEARANCE 06085

10.12 Starter Solenoid

10.12.1 Description

The starting motor solenoid shifts the starting motor pinion into mesh with the flywheel ring gear and also closes the electric circuit to energize the starting motor.

There are two windings in the solenoid: a pull-in winding and a hold-in winding. Both windings are energized when the external control switch is closed. They produce a magnetic field which pulls the plunger in so that the drive pinion is shifted into mesh, and the main contacts in the solenoid switch are closed to connect the battery directly to the starting motor. Closing of the main switch contacts shorts out the pull-in winding since this winding is connected across the main contacts. The magnetism produced by the hold-in winding is sufficient to hold the plunger in, and shorting out the pull-in winding reduces drain on the battery. When the control switch is opened momentarily, the pull-in winding and the hold-in winding are connected in series between the battery and common ground.

The polarity of the pull-in winding is reversed and opposes the magnetic pull of the hold-in winding. All magnetic holding force on the solenoid plunger is thus canceled. The return spring then quickly pulls the solenoid plunger back, opening the solenoid switch contacts and at the same time withdrawing the pinion gear from the meshing position. Proper operation of the switch depends on maintaining a definite balance between the magnetic strength of the pull-in and hold-in windings.

This balance is established in the design by the size of wire and the number of turns specified. An open circuit in the hold-in winding or attempts to start with a discharged battery may cause the switch to chatter.

10.12.2 Disassembly

To disassemble the solenoid, remove nuts, washers, and insulators from the switch terminal and battery terminal. Unscrew cover screws and remove cover. Take out the contact disk assembly.

10.12.3 Solenoid Maintenance

The solenoid requires no periodic maintenance other than keeping the terminals clean and tight. Always check action of the solenoid if it has been removed. If the unit fails to function, first check wiring before condemning the solenoid. Solenoid windings can be checked for current draw, open circuit, or shorts.

10.12.4 Solenoid Tests

Two tests must be made to determine the current draw of (1) both windings in parallel and (2) the hold-in winding alone. The solenoid windings can be tested with the solenoid either off or on the starting

motor. However, when the solenoid is checked on the starting motor, it is necessary to disconnect both leads at the main solenoid terminals to prevent interference. The main solenoid terminal which is normally connected to the starting motor must then be grounded to the solenoid base by means of a jumper lead. For the first test, connect a source of variable voltage (battery and a variable resistance) in series with an ammeter between the solenoid base and the solenoid small switch terminal. Connect a voltmeter between the same two points. Slowly increase voltage and note the current draw. This should be 55-63 amps at 24 volts. Disconnect the jumper lead grounding the main solenoid terminal and readjust the variable resistance to obtain the specified voltage of 24 volts. This should not exceed 6.8 amperes.

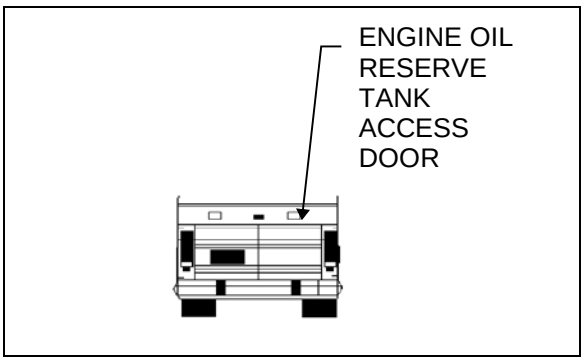
When the solenoid has been removed from the starting motor for repair or replacement, the linkage must be adjusted to provide the correct pinion clearance when the solenoid is remounted on the starting motor. See paragraph *"10.11 Pinion Clearance"* earlier in this section for correct adjustment.

10.12.5 Recommendations

1. Tag each lead to ensure correct connections when the starting motor is reinstalled.
2. Tighten the 5/8"-11 starter attachment bolts to a torque of 137-147 lbf•ft (186-200 N•m).
3. Keep all the electrical connections clean and tight.
4. When installing wiring terminal leads to the starting motor and the solenoid switch, torque the No. 10-32 connections to 16-30 lbf•in (2-3 N•m) and the 1/2"-13 connections to 20-25 lbf•ft (27-34 N•m).

11. ENGINE BLOCK HEATER

The vehicle may be equipped with an engine immersion-type electric block heater to assist cold weather starting. The heater male electric plug is easily accessible through the engine oil reserve tank access door (Fig. 91). To use it, connect the female plug of an electrical extension cord to the heater plug. Some converted vehicles may have the heater connected to the coach AC power system. The extension cord must be plugged into a 110-120 V AC power source only. The engine block heater should be used whenever the vehicle is parked for an extended period of time in cold weather and a suitable power source is available.



06149

FIGURE 91: HEATER MALE ELECTRIC PLUG LOCATION

CAUTION: ***Use only a 110-120 V AC power source. Extension cord must be of the grounded type (three prongs) and have a minimum rated capacity of 15 amps. Be sure to disconnect cord before starting and/or moving the vehicle.***

11.1 Maintenance

This heater is non-serviceable except for the cord, and if faulty, must be replaced as a unit.

12. EXTERIOR LIGHTING EQUIPMENT

Circuit for exterior lights as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams, annexed in the technical publication box provided with the vehicle.

12.1 Headlight

Each headlight consists of a 12 volts halogen unit.

12.1.1 Headlight Dimmer Switch

The multifunction lever located on the steering column is used to select proper lighting. High beams or low beams can be selected by respectively pushing the lever towards the dashboard or pulling it towards the driver. A high beam indicator on the central dashboard panel is illuminated when the high beam circuit is energized.

Note: ***High beams can be flashed momentarily by pulling the lever completely towards the driver and then releasing it.***

12.1.2 Maintenance

Clean with soap and water and a good glass cleaner whenever dirty. For maximum illumination, headlight connections must be coated with a dielectric grease to prevent oxidation and proper voltage must be maintained. Low battery voltage, loose or dirty contacts in wiring system and poor ground contribute to a decrease in voltage. Check wiring and connections regularly and keep battery properly charged. When a headlight bulb burns out, a new bulb must be installed. Do not perform headlight aiming after a bulb replacement.

Headlight aim can be checked if necessary (after reparation on headlight assembly). Headlights must be properly aimed to provide maximum allowable road illumination. When using mechanical aimers, follow manufacturer's instructions.

Aiming can be performed by removing headlight bezels. Horizontal and vertical aiming of each headlight provided by two adjuster screws (Fig. 92). There is no adjustment for focus.

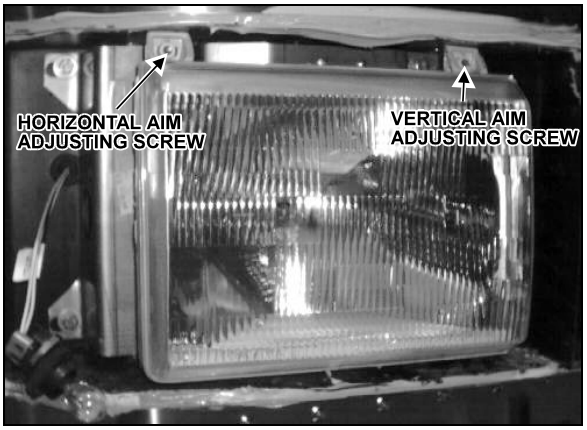


FIGURE 92: RIGHT HEADLIGHT 06150

12.1.3 Headlight Adjustment

The following is a general procedure for headlight adjustment using a mechanical equipment, such as a *"Bear 47-132 headlight aligner"*. If your mechanical equipment is different, refer to the manufacturer's instruction manual.

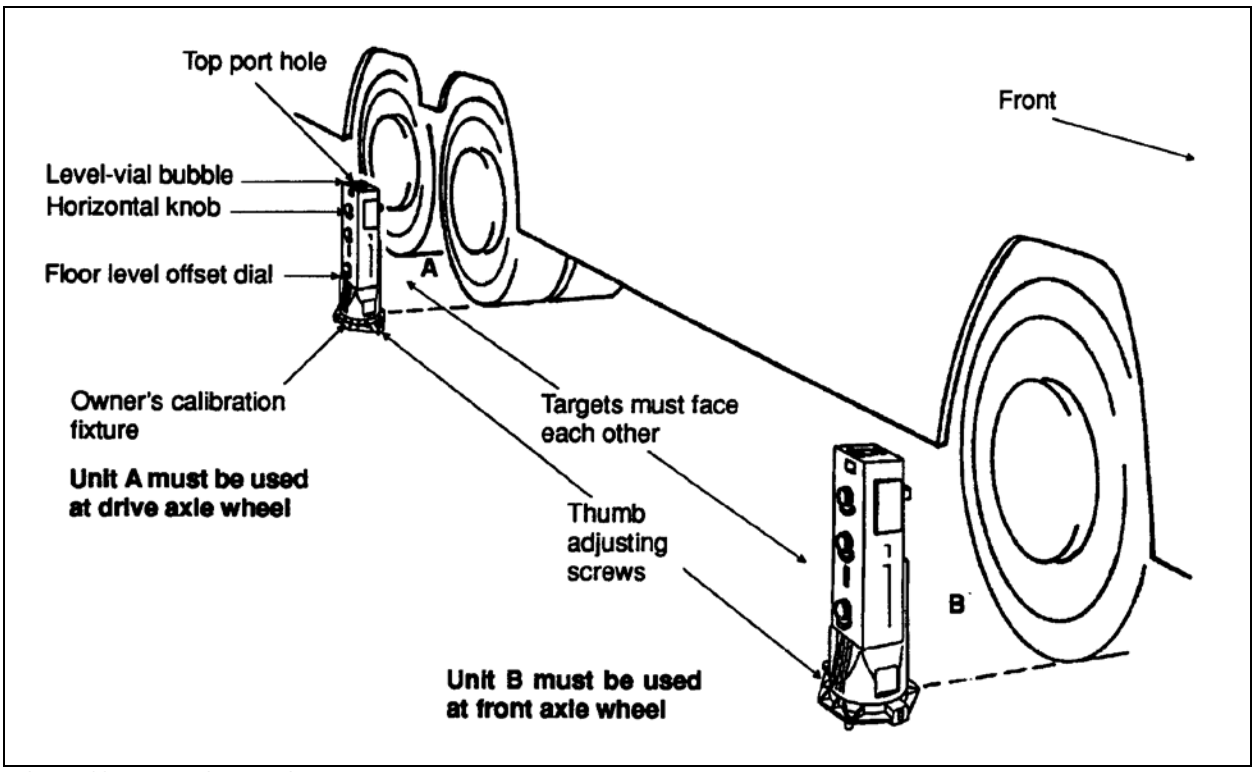


FIGURE 93: HEADLIGHT ALIGNER 06087

Setting aligner according to slope

The floor level offset dial must match with slope to ensure a precise alignment.

1. Park vehicle on a level floor.
2. Fix one (1) calibration fixture to each aligner.
3. Install aligner in center of each wheel on one side of vehicle. Unit B must be installed besides the front axle wheel with its viewing port facing rearward, and unit A besides the drive axle wheel with its viewing port facing forward. See figure 93 for more details.

Note: ***Check that the three indicators on each module are set to the zero point.***

4. Level each unit by means of the thumb adjusting screw on the fixture until level-vial bubble is centered.
5. Look through the top port hole of unit A, and turn horizontal knob until split images are aligned. See figure 94.

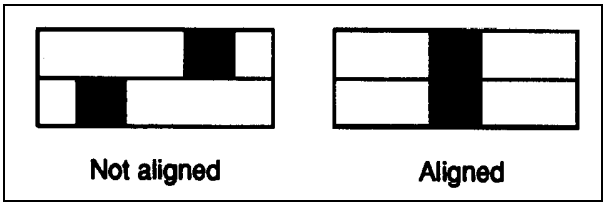


FIGURE 94: HEADLIGHT ALIGNER 06088

6. Set according to floor slope. Transfer positive (+) or negative (-) reading of horizontal dial to the floor level offset dial to offset floor slope on each aligner (Fig. 95). Push on the floor level offset dial to register reading.
7. Remove calibration fixture from each unit.

Note: ***If vehicle remains stationary during the headlight alignment procedure, avoid checking floor slope each time.***

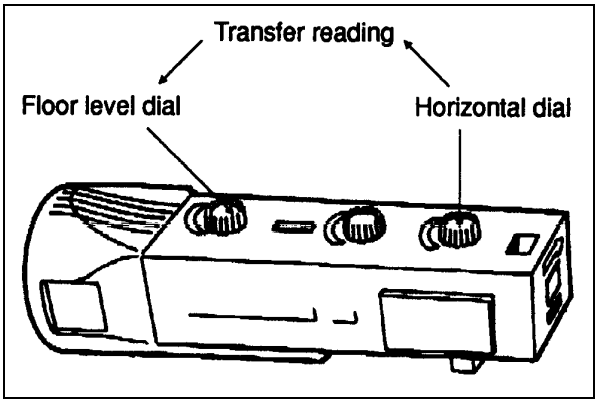


FIGURE 95: HEADLIGHT ALIGNER 06089

Headlight alignment

1. To gain access to horizontal and vertical aim adjusting screw, remove screws attaching headlight bezel to front panel ("Phillips" screws). Remove bezel.

Note: ***The aligner is provided with adapters for different sizes of headlights which are always aligned in pairs.***

2. Fix the adequate adapter on each headlight.

Note: ***The adapters are equipped with steel inserts, thus providing a good seating for a precise headlight adjustment.***

3. Install aligners on headlights (unit A on driver's side and unit B on other side with the sight openings facing each other), by pushing the handle forward to secure rubber suction disc, then pull handle until it locks. Refer to fig. 96.

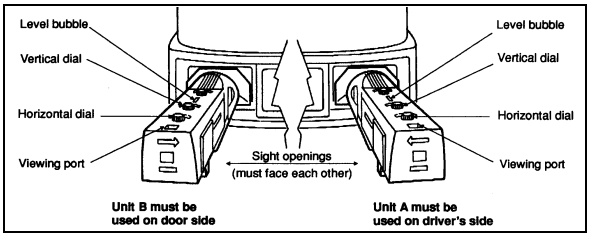


FIGURE 96: HEADLIGHT ALIGNER 06090

Note: ***Ensure that floor level offset dial is set adequately before aligning headlights.***

Horizontal alignment

1. Reset horizontal dial to zero.
2. Check that split image is visible in the viewing port. If not, replace aligner by turning it.
3. Turn the horizontal aim adjusting screw of each headlight with a six-point standard socket until split image is aligned (Fig. 97).

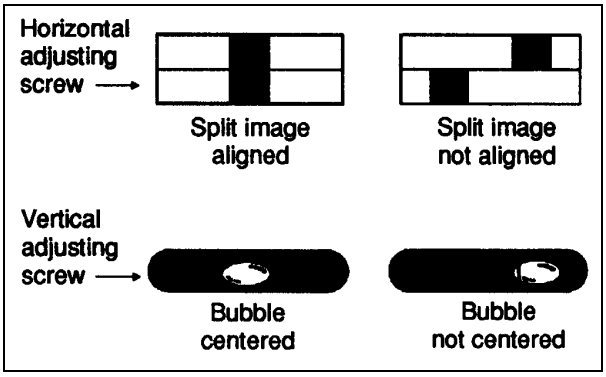


FIGURE 97: HEADLIGHT ALIGNER 06091

Vertical alignment

1. Reset vertical dial to zero.
2. Turn the adjusting screw of the headlight vertical aim with a six-point standard socket until bubble is centered (see fig. 97). Repeat operation on other headlight.
3. Recheck the horizontal alignment.

Remove aligners by pressing on vacuum release button.

Repeat the same procedure for the high beams.

If mechanical equipment is not available, perform adjustments as described below:

1. Park vehicle on level floor so headlights are 25 feet (7,6 m) from a smooth surface preferably of light color. A door or wall is suitable. Center line of vehicle should be perpendicular to this vertical surface.
2. Draw a horizontal line on vertical surface at height of light center. Locate point on this horizontal line at which projected centerline of vehicle intersects. Measure distance between light centers and divide this distance equally on either side of center mark. Then draw two vertical lines directly ahead of each light center.
3. Switch on high beams and cover one headlight while adjusting the other.
4. When aiming headlights, beam may appear distorted. A new sealed-beam unit must be installed to correct this condition.
5. After headlight is properly aligned, cover it and proceed in the same manner as above with opposite headlight.

12.1.4 Bulb Replacement

Replace headlight bulb as follows (Fig. 98):

1. Remove screws attaching headlight bezel to front panel (*"Phillips"* screws) and remove bezel.

2. Remove the tree (3) cap screws and the two (2) *"Phillips"* screws attaching headlight to headlight casing.
3. Pull wiring connector off back of unit.
4. Remove headlight unit from its casing.
5. Remove the bulb retainer. Remove the bulb from headlight.
6. Replace the new bulb.
7. To reassemble headlight assembly, do the previous step of this procedure in a reverse sequence.

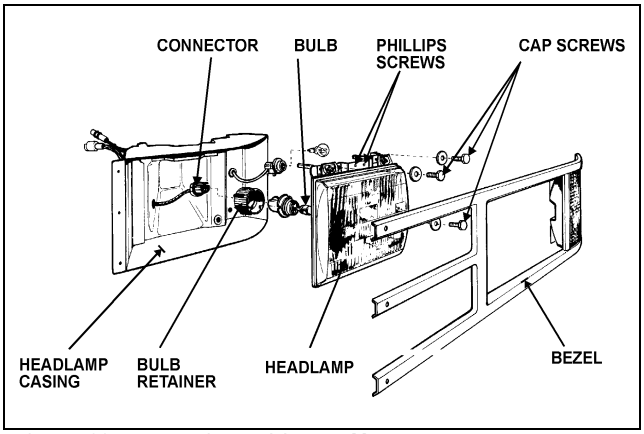


FIGURE 98: HEADLIGHT ASSEMBLY 06151

Note: ***Do not adjust headlight after a simple bulb replacement.***

Note: ***Uses silicone (Prevost #680027) to seal the bezel.***

12.2 Front Turn Signal

The front turn signal is a part of the front headlight cluster. The turn signal lens is located on each front corner and shares a common bezel with the headlights. Turn signal is visible from both front and side.

12.2.1 Bulb Removal and Replacement

Replace front turn signal bulb as follows:

1. Remove the *"Phillips"* screws attaching the headlight bezel, then remove it.
2. Remove socket from headlight bezel.
3. Pull the bulb out of the socket.
4. To reassemble front turn signal assembly, do the previous step of this procedure in a reverse sequence.

12.3 Stop, Tail, Rear Directional, Back-up, and Hazard Warning Lights

A combination stoplight, taillight, rear directional signal light and back-up light assembly is mounted on each side at rear of vehicle. Furthermore, when braking, a center stoplight will illuminate simultaneously with the stoplights for increased safety.

The stop, tail, directional signal and back-up lights consist of individual bulbs mounted in a common housing, and each light is serviced individually as a complete unit and need only to be plugged into or unplugged from socket after removing proper light lens.

The hazard warning flashing system uses simultaneously the front, side, and rear directional lights. This system is energized by a switch on the R.H. lower switch panel.

12.3.1 Bulb Removal and Replacement

1. Unscrew the retaining lens screws (2), then remove the lens.
2. Remove the bulb by pushing and twisting off from its socket.
3. Place the new bulb. To reassemble, do the previous step of this procedure in a reverse sequence.

Note: ***Taillights are provided with a different candle power bulb. Be sure to replace defective bulb by the appropriate one.***

12.4 License Plate Light

Two sealed units are mounted above the rear license plate(s) of vehicle. In case of burn out, the sealed unit must be changed according to the following procedure (Fig. 99).

1. Pry out the rubber seal with a little screwdriver, then pull on the sealed unit and disconnect it.
2. Reconnect new sealed unit, place rubber seal, and press on it until it is seated in its former position.

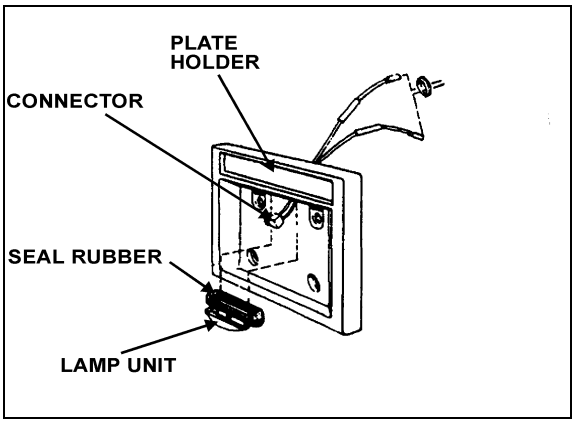


FIGURE 99: LICENSE PLATE HOLDER 06152

12.5 Clearance, Identification and Marker Lights - Bulb Removal and Replacement

XL vehicles are equipped with marker, identification and clearance lights. The clearance lights are mounted at each corner of the coach near the top and the identification lights in upper center of rear and front sections. They are red at the rear and yellow at the front.

The yellow marker lights are mounted along the sides of vehicle.

12.6 Marker / Side Directional Lights - Bulb Removal and Replacement

The side marker light and side directional light bulb should be replaced as per the following procedure (Fig. 100):

1. Unscrew both *"Phillips"* lens screws, then remove the lens.
2. Push in and twist off the bulb from its socket.
3. Place the new bulb.
4. Position lens on housing, then place and screw the *"Phillips"* screws.

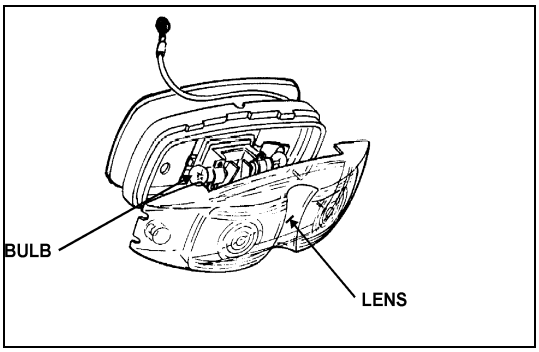


FIGURE 100: MARKER LIGHT / SIDE DIRECTIONAL LIGHT 06153

12.7 Clearance / Identification Lights - Bulb Removal and Replacement

Two types of clearance lights can be installed on your vehicle (type "A" & "B").

Replace type "A" bulb light as per the following procedure (Fig. 101):

1. Unscrew the "Phillips" lens screws. Remove the lens.
2. Pull the bulb straight out to remove it from its socket. Do not try to turn the bulb to remove it.
3. Place the new bulb by pushing it in socket.
4. Position lens on housing, then place and screw the "Phillips" screws.

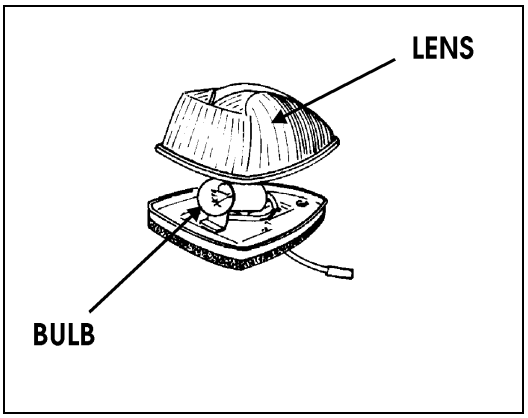


FIGURE 101: TYPE "A" LIGHT BULB 06154

Replace type "B" bulb light as per the following procedure (Fig. 102):

1. Unscrew both *"Phillips"* lens screws, then remove the lens and housing.
2. Twist the bulb socket and pull out.

3. Pull the bulb straight out to remove it from its socket. Do not try to turn the bulb to remove it.
4. Place the new bulb by pushing it in socket.
5. Position lens on housing, then place and screw the *"Phillips"* screws.

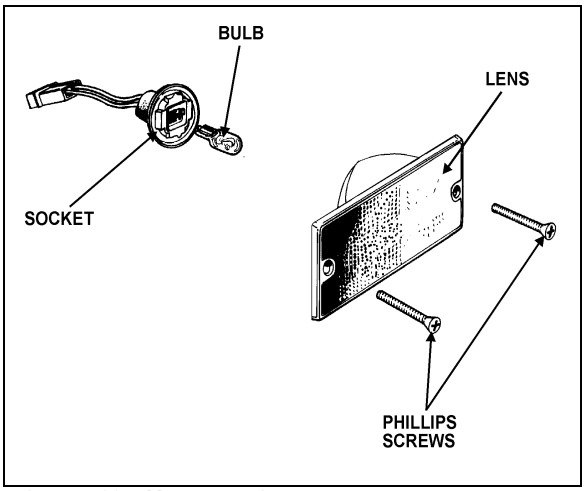


FIGURE 102: TYPE "B" LIGHT BULB 06155

Identification Bulb Removal and Replacement

Replace the identification light bulb as per the clearance bulb Removal and Replacement procedure of type "B".

12.8 Docking / Cornering Lights - Bulb Removal and Replacement

XL converted vehicles are provided with two halogen headlights that serve as cornering lights. They are mounted on the vehicle as follows: One is mounted on the front L.H. side steering compartment door, while the other is located on entrance door on the R.H. side.

Two additional halogen headlights are installed on both side off the vehicle (between drive wheels and the last baggage compartment). These lights are used as docking lights.

The main function of docking and cornering lights is to increase lateral visibility when turning a corner.

When the rocker switch located on console with central A/C system is set to the "Docking" position, the four (4) lamps light simultaneously in order to facilitate "Docking" procedure.

When the switch is set to the "Cornering" position and the left or right turn signal is selected, the corresponding cornering light will illuminate to increase visibility.

Both docking and cornering headlights can be changed according to the following procedure (Fig. 103):

1. Unscrew the two *"Phillips"* screws of the retaining ring.
2. Disconnect the light unit connection.
3. Press on each tab of retaining clip, bring both tabs together, then lift the retaining clip.
4. Remove the bulb.
5. Position new bulb, place the retaining clip, then bring both tabs together; when the retaining clip is in position, release the tabs.

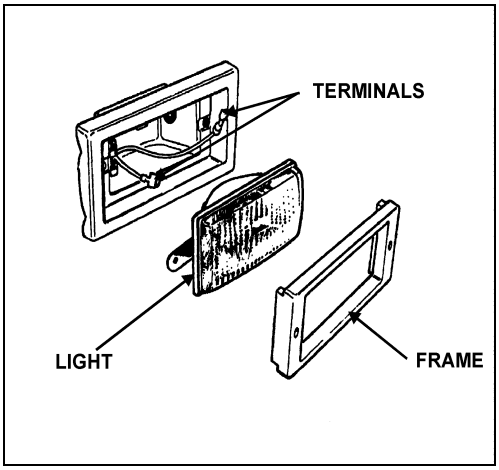


FIGURE 103: DOCKING AND CORNERING 06156

Caution: ***During this step, avoid contacting the bulb with your fingers, otherwise this could alter the bulb life.***

6. Connect and then position the light unit.
7. Finally, place and screw the retaining ring.

12.9 Fog Light - Bulb Removal and Replacement

Optional halogen fog lights can be mounted on this vehicle to allow the driver a better visibility in foggy weather, or to improve the range of vision just ahead of the coach.

Replace fog lights as per the following procedure (Fig. 104):

Warning: ***Care should be taken when opening this compartment since bumper weighs 100 lb. (45 kg).***

Caution: ***The two (2) bumper retaining bolts should be checked to make sure they are tightly fastened.***

1. Carefully remove the large bolt at each end of the front bumper using the wheel nut wrench, then slowly lower down the front bumper.
2. Remove the cover on light unit (if so equipped), then unscrew the light unit retainer screw and slide upward the retainer.
3. Remove the light unit, then disconnect the light unit connection.
4. Move the tabs of retaining clip out of its notches, then lift the retaining clip and remove the bulb.
5. Place the new bulb, then replace the retaining tab of clip to its position into the notches.

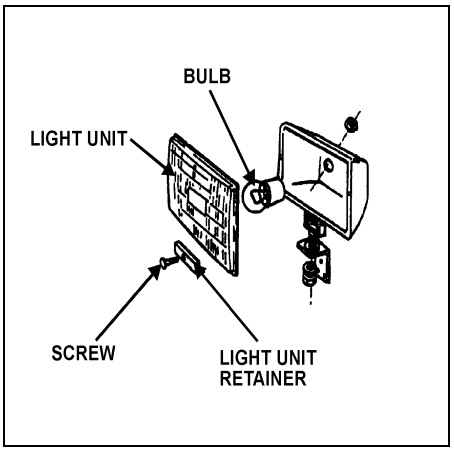


FIGURE 104: FOG LIGHT 06157

Caution: ***During this step, avoid contacting the bulb with your fingers, otherwise this could alter the bulb life.***

6. Reconnect the light unit connection, then place the light unit to its proper position.
7. Replace the retainer and screw it.
8. Replace the light unit cover (if so equipped).

13. INTERIOR LIGHTING EQUIPMENT

13.1 Control Panels Lightning

The instrument gauges and switches mounted on all control panels are energized whenever the exterior light switch is pushed to the first position. A control dimmer located on the dashboard is used to vary progressively the brightness of the panel gauges switches and indicator lights as the control knob is rotated clockwise.

The gauge lights, panel lights, switch lights and indicator lights have a different bulb arrangement. Thus, the procedure to change a defective bulb can vary according to the application.

13.1.1 Switch Bulb Replacement

Replace switch light bulb as per following procedure (Fig. 105):

1. Remove the defective switch bulb control panel by removing "Phillips" screws.
2. The light bulb socket may be removed by pulling it away from behind control panel. Remove the defective bulb.
3. Push the new bulb into the socket to install it.
4. Place the light socket and push to its former position.
5. Replace the control panel.

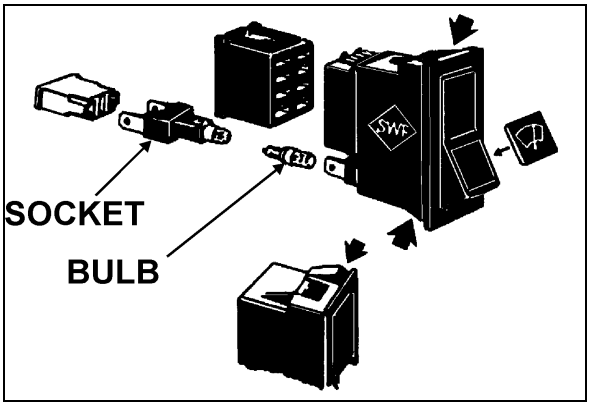


FIGURE 105: SWITCH 06092

13.1.2 Indicator Light Bulb Replacement

Replace indicator light bulb as per following procedure (Fig. 106):

1. Remove dashboard panel by removing the five (5) "Phillips" screws.
2. Locate the defective light.

3. Access bulb by pulling out socket while applying lateral pressure.
4. Pull out defective bulb from socket and replace it with a new one.
5. Replace socket in light housing.
6. Replace dashboard panel.

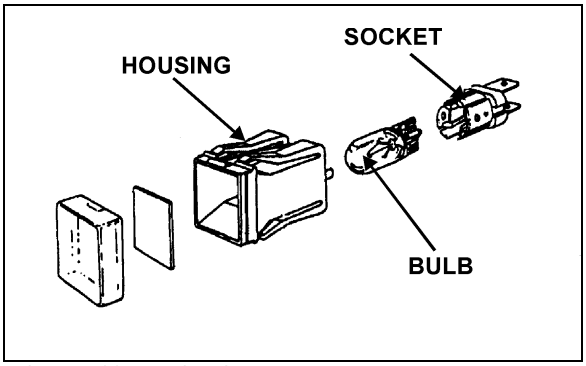


FIGURE 106: INDICATOR 06158

Note: ***The bulbs of the "Check engine" and "Stop engine" warning lights as well as those for the flasher indicator lights are 12 volts instead of 24 volts as in the case of all other indicator/warning lights.***

13.1.3 Gauge Light Bulb Replacement

Replace gauge light bulb as per the following procedure (Fig. 107):

1. For any gauge light bulb replacement, the dashboard panel must be removed in order to have access to the rear of gauges.
2. Remove bulb socket from the gauge, turn the defective bulb counterclockwise and pull it out of the socket.
3. Push a new bulb into the socket and turn it clockwise to lock the bulb in place.
4. Replace bulb socket in gauge and replace the dashboard panel.

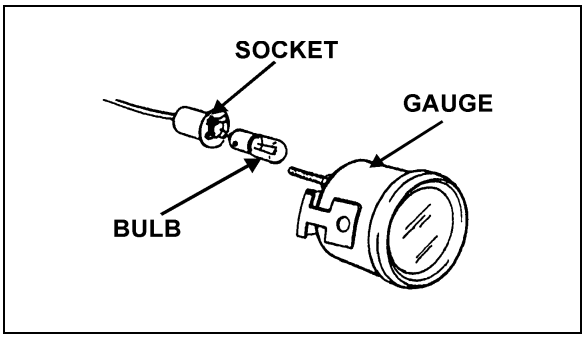


FIGURE 107: GAUGE LIGHT BULB 06159

13.1.4 Panel Light Bulb Replacement

Panel light bulbs are mounted on the R.H. console and serve to illuminate control switches such as the heating system control switches.

Replace the panel light bulb as per the following procedure:

1. Unscrew the bulb light holder from the console.
2. Remove the bulb light from its holder.
3. Place the new bulb into the holder, then screw in the holder on the console.

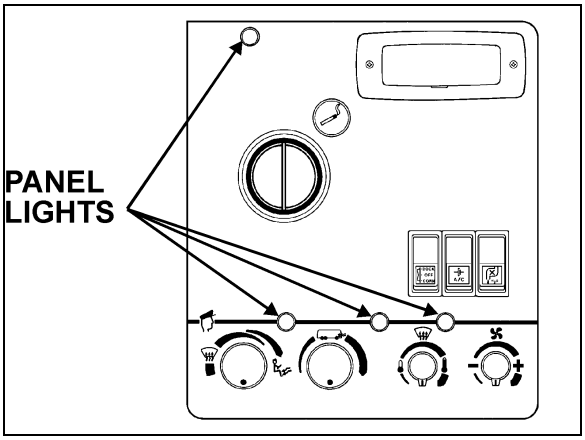


FIGURE 108: A/C STANDARD CONSOLE 06160

13.2 Stepwell Light

Stepwell lights are illuminated when the door opening system is activated. The light bulbs are accessible after removal of the light lens which is held to the housing with two Phillips-head screws.

13.2.1 Bulb Removal and Replacement

Replace stepwell lights bulb as per the following procedure (Fig. 108):

1. With the light lens removed, pull out bulb from the lamp while applying lateral pressure.
2. Place the new bulb into the lamp.
3. Place the light lens and screw it in place.

13.3 Dome, Rear Roof and Lavatory Lights

Two dome lights (each provided with two bulbs) are installed over the stepwell and in driver's compart-

ment. These lights are frequently used for nighttime operation when passengers board or leave coach.

This type of light is also install in the lavatory and on the rear roof.

13.3.1 Bulb Removal and Replacement

Replace dome, rear roof and lavatory lights bulb as per the following procedure:

1. Unsnap the lens with a flat head screwdriver and remove it.
2. Push and turn the defective bulb counterclockwise, then pull it out of the socket.
3. Place the new bulb, push and turn clockwise until it locks in position.
4. Replace the lens and snap it back in place.

13.4 Passenger Section Lightning

The passenger's section of vehicle is lighted by two types of fluorescent tube lamps installed on parcel racks. The aisle fluorescent lights are located on front of parcel racks, while fluorescent lights for general and in-station lighting are located under the parcel racks (Fig. 109). A dual power system is available for this lighting either from the 24 volt vehicle power supply or from a 110 volt outlet supply. In order to save batteries during extended periods of in-station lighting, no current is drawn from the batteries as soon as the 110 volt circuit is connected. Moreover, adjustable reading lamps are installed under parcel racks for passenger accommodation.

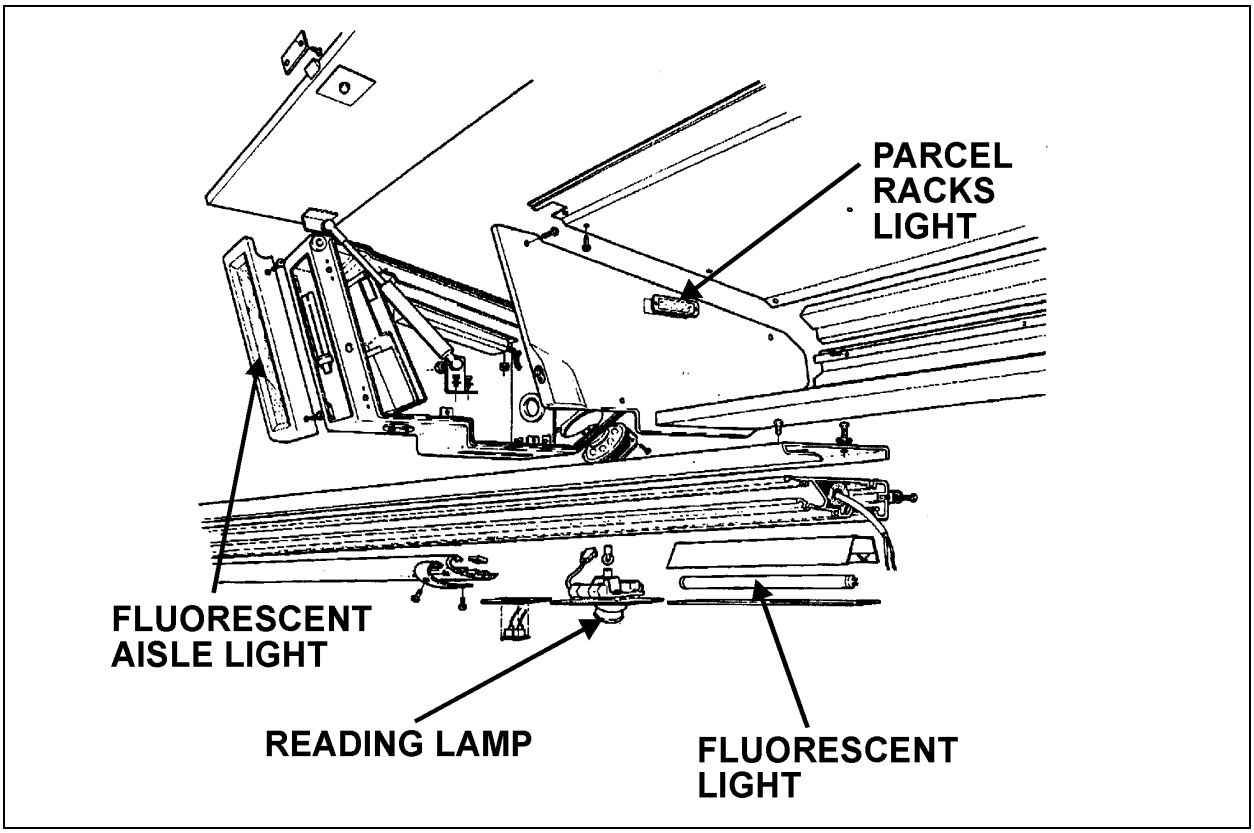


FIGURE 109: PARCEL RACK0609

13.4.1 Removal and Replacement of Aisle Fluorescent Light

Replace aisle fluorescent light as per the following procedure (Fig. 109):

1. Remove the front bezel by unscrewing the four *"Phillips"* side screws (two each side), then the lens.
2. Pull out the fluorescent from its base.
3. Place a new fluorescent and push on until the proper position is reached.
4. Replace lens bezel, and screw it.

13.4.2 Removal and Replacement of Fluorescent Light

Replace fluorescent light as per the following procedure (Fig. 109):

1. Push on the screen lens of fluorescent in order to unsnap it.
2. Rotate and pull out the fluorescent tube from its socket.
3. Place the new fluorescent tube and rotate the tube to secure it in its socket.

12.4.3 Reading Lamp - Bulb Removal and Replacement

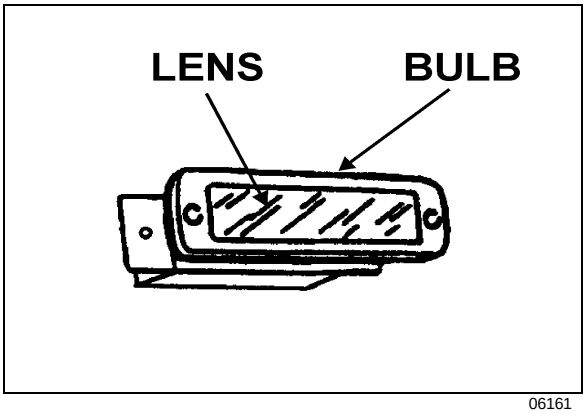
Replace reading lamp bulb as per the following procedure (Fig. 109):

1. Slide lightly the reading lamp and pull in order to unsnap it.
2. Turn over the reading lamp and unscrew both screws of the retaining socket support.
3. Push and turn bulb counterclockwise, then pull it out of the socket.
4. Place new bulb into the socket, then push and turn clockwise to lock bulb in position.
5. Place retaining socket support and screw in place.
6. Position the reading lamp and press until it snaps.

13.4.4 Parcel Rack / Lavatory Night Light - Bulb Removal and Replacement

Replace parcel rack bulb light and Lavatory night light bulb as per the following procedure (Fig. 109 and 110):

1. Unscrew the two (2) "Phillips" lens screws.
2. Push and turn the defective bulb counter-clockwise, then pull it out of the socket.
3. Place the new bulb, push and turn clockwise until it lock in position.
4. Replace the lens on housing, then place and screw the "Phillips" screws.



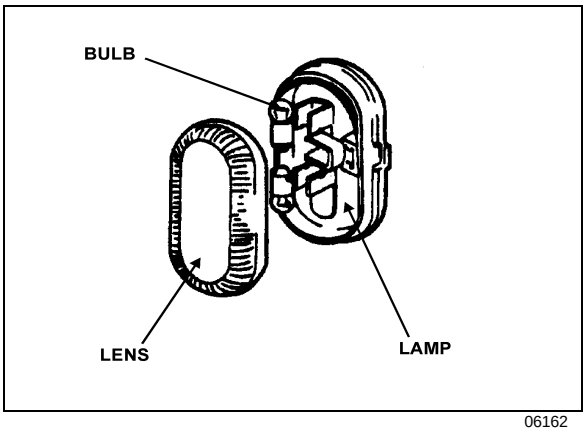
06161

FIGURE 110: PARCEL RACK / LAVATORY NIGHT LIGHT

13.4.5 Lavatory "Occupied" Light - Bulb Removal and Replacement

Replace lavatory "occupied" light bulb as per the following procedure (Fig. 111):

1. Unsnap the lens with a flat head screwdriver and remove it.
2. Push and turn the defective bulb counterclock-wise, then pull it out of the socket.
3. Place the new bulb, push and turn clockwise until it locks in position.
4. Replace the lens and snap it back in place.



06162

FIGURE 111: LAVATORY "OCCUPIED" LIGHT

13.4.6 Emergency Exit Light - Bulb Removal and Replacement

This blue tinted light is located in the upper section of emergency side window.

Replace emergency exit light bulb as per the following procedure (Fig. 112):

1. (If applicable) remove the venetian blind by removing is four (4) "Phillips" screws.
2. Remove the plastic panel by unscrewing the five (5) "Phillips" screws.
3. Change the bulb.

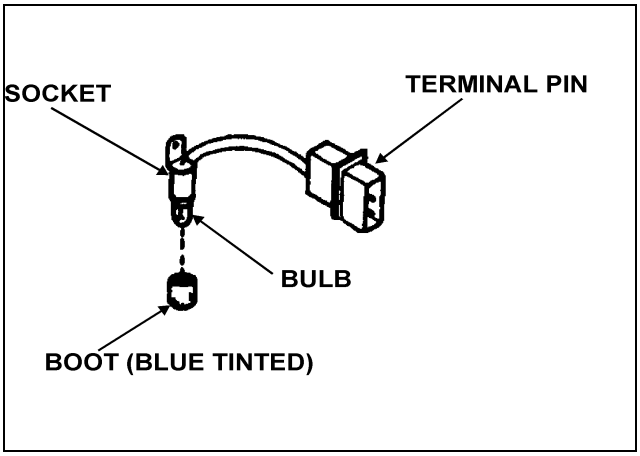


FIGURE 112: EMERGENCY EXIT LIGHT 06163

13.4.7 Destination Sign Light - Bulb Removal and Replacement

Replace destination sign light bulb as per the following procedure:

1. Raise the destination sign panel.
2. Push and turn the defective bulb counterclockwise, then pull it out of the socket.
3. Place the new bulb into the socket, then push and turn clockwise to lock bulb in position.

13.4.8 Destination Sign - Fluorescent Removal and Replacement

Replace destination sign fluorescent as per the following procedure:

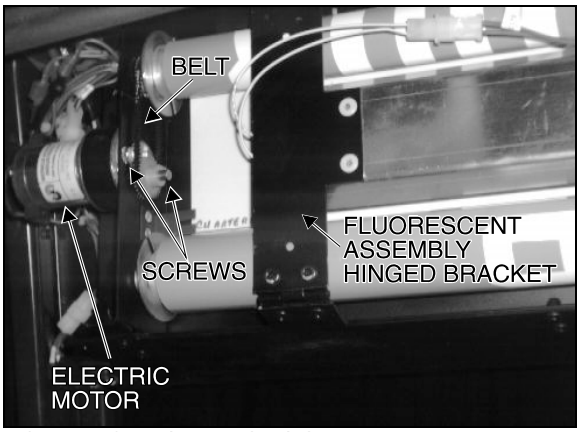


FIGURE 113: DESTINATION SIGN 23034

1. Remove the six Phillips-head screws and washers retaining the destination sign cover, then carefully remove the cover from its location.
2. Remove both Phillips-head screws, one on each fluorescent assembly hinged bracket (Fig. 8), then lower assembly.
3. Push on tab located on each fluorescent pin receptacle while removing fluorescent.
4. Install new fluorescent, then reinstall the assembly by reversing the above procedure.

13.4.9 Aisle Light - Bulb Removal and Replacement

To locate this type of light see under passenger seats. Replace aisle light bulb as per the following procedure (Fig. 113):

1. Remove the cap protector.
2. Pull out the defective bulb.
3. Place a new bulb and boot and push on until the proper position is reached.
4. Replace the cap protector.

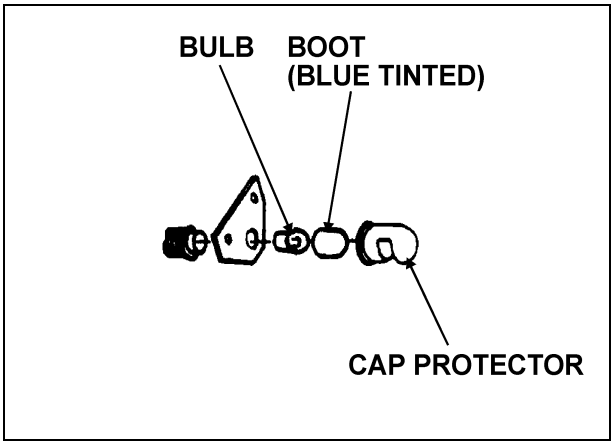


FIGURE 114: AISLE LIGHT 06164

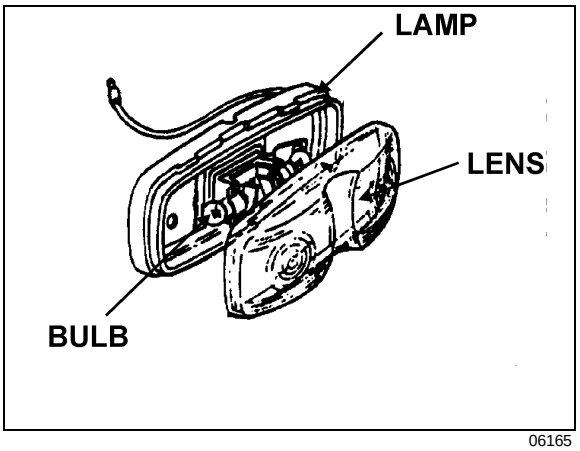
13.5 Engine and Front Electrical Compartment Lightning

A switch located on R.H. side of rear junction box can be used to actuate the engine compartment lights.

The front electrical compartment light is controlled by a microswitch upon opening of the door.

Each light is provided with two bulbs which can be replaced as follows (Fig. 114):

1. Remove the lens by the use of a flat screwdriver to pry the lens out.
2. Push and turn the defective bulb counterclockwise, then pull it out of the socket.
3. Place the new bulb into the socket, then push and turn clockwise to lock bulb in position.
4. Place the lens, and snap it in place.



06165

FIGURE 115: ENGINE AND FRONT ELECTRICAL LIGHT

13.6 Exterior Compartment Lights (Except Engine And Front Electrical Compartment)

Replace exterior compartment lights as per the following procedure:

1. Unscrew the two (2) "Phillips screws" located on both side of the bulb housing.
2. Push on both retaining bulb clips and remove the bulb.
3. Place new bulb between the retaining bulb clips.
4. Position housing, then place and screw the "Phillips" screws.

14. LIGHT BULB DATA

When replacing a light bulb, special attention must be paid to the voltage rating (refer to light bulb data hereafter).

Note: ***Note that all exterior lights are 12 volts, except exterior compartment which are 24 volts. All interior lighting are 24 volts, except for the "Check engine" and "Stop engine" warning lights and flasher indicator lights which are also on 12 volt system.***

LIGHT BULB DATA

APPLICATION	PREVOST PART NO.	TRADE OR SAE NUMBER	WATTS OR CANDLE POWER	VOLTS	QTY XL-40 COACH	QTY XL-45 COACH	QTY CONVERTED VEHICLE
EXTERIOR LIGHTING							
Headlight Hi/Lo	930291	9004	65 W/45 W	12	2	2	2
Docking & cornering	561882	H3(Osram)	55 W	12	---	---	4
Fog (Optional)	561882	H3(Osram)	55 W	12	2	2	2
License plate (sealed)	930266	---	12 W	12	2	2	2
Side directional	561917	1893	2 cp.	12	12	12	12
Side marker	561917	1893	2 cp.	12	12	12	12
Identification	562059	194	2 cp.	12	6	6	6
Clearance	562059	194	2 cp.	12	8	8	8
Front directional (hazard & marker)	562135	3057	32/3 cp.	12	2	2	2
Rear directional	560589	1156	32 cp.	12	8	8	8
Stop	560589	1156	32 cp.	12	8	8	8
Back-up	560589	1156	32 cp.	12	4	4	4
Center stop	560589	1156	32 cp.	12	2	2	2
Tail	560123	67	4 cp.	12	8	8	8
Exterior compartment (except engine)	562278	6429 (78207)	10 W	24	12	12	12
Engine compartment	560601	456	2 cp.	24	8	6	6
INTERIOR LIGHTING							

LIGHT BULB DATA

APPLICATION	PREVOST PART NO.	TRADE OR SAE NUMBER	WATTS OR CANDLE POWER	VOLTS	QTY XL-40 COACH	QTY XL-45 COACH	QTY CONVERTED VEHICLE
Check engine	562048	E-9 (Norma)	2 W	12	1	1	1
Stop engine	562048	E-9 (Norma)	2 W	12	1	1	1
Flasher indicator	562048	E-9 (Norma)	2 W	12	2	2	2
Other indicator - 1/unit	562049	(Osram)	2 W	24	AR	AR	AR
Speedometer	560145	1829	1 cp.	24	2	2	2
Pyrometer (Opt)	560601	456	2 W	24	1	1	1
Tachometer	560145	1829	1 cp.	24	2	2	2
Turbo boost (Opt)	561167	3899 (Osram)	3 W	24	1	1	1
Tachograph (Opt)	561006	1-405-804	1.2 cp.	24	3	3	3
Other instrument - 1/unit	560144	1820	1.6 cp.	24	AR	AR	AR
Step	562278	6429 (78207)	10 W	24	3	3	3
Driver's area	561553	78236	10 W	24	4	4	4
Lavatory	561553	78236	10 W	24	2	2	---
Lavatory night light	560601	456	2 cp.	24	2	1	---
Lavatory “Occupied”	560702	1843	0.2 cp.	24	2	2	---
Parcel racks	560144	1820	1.6 cp.	24	14	12	---
“Emergency exit”	560601	456	2 cp.	24	20	14	---
Aisle	560141	1251	3 cp.	24	7	6	---
Switch 1/unit	561123	2741 (Osram)	1 W	24	AR	AR	---
Reading	562033	961-4940	8 W	24	AR	AR	---
Fluorescent	830102	F15T8 CW	15 W	---	27	21	---
Destination sign bulb	560141	1251	3 cp.	24	6	6	---

LIGHT BULB DATA

APPLICATION	PREVOST PART NO.	TRADE OR SAE NUMBER	WATTS OR CANDLE POWER	VOLTS	QTY XL-40 COACH	QTY XL-45 COACH	QTY CONVERTED VEHICLE
Destination sign fluorescent tube	830120	F30TBCW4	20 W	24	1	1	---
Parcel rack front neon	830108	PL7	7 W	---	16	14	---
Rear roof	561553	78236	10 W	24	2	2	--
R.H. lateral console	562278	6429 (78207)	10 W	24	1	1	1

15. SPECIFICATIONS

BATTERY

Make.....Delco-Remy
Model.....1150
Type..... Maintenance-free
Terminal type.....Top Stud
Group size 31
Volts.....12
Load test amperage *.....290
Reserve capacity (minutes).....180

Cold cranking (in amps)
- At 0 °F (-18 °C)..... 625 (each battery)
- At -20 °F (-29 °C) ..... 490 (each battery)

Maximum dimensions (inches/mm)
- Length (including flange)..... 13.0/330,2
- Width 6.8/172,7
- Height (including top posts) 9.4/238,8
- Approximate weight (lb./kg) 60/27,2

* *Battery tester cable clamps should be between terminal nuts and lead pads of terminals. If not possible, load value should be 210 amperes.*

Torque specifications

Battery cable to post.....10-15 lbf·ft (13-20 N·m)
Battery cover .....45-50 lbf·in (5-6 N·m)

ELECTRICAL SYSTEM MONITOR

Make.....Vanner
Model.....EM-70
Input..... 24 V dc
System high.....greater than 30 V dc
System low .....less than 24 V dc
Trip level ..... ± 0.75 V dc
Prévost number 562058

ALTERNATOR 24V.-270 AMPS

Make.....Delco-Remy
Model Number..... 1117863
Prévost Number 562235

ALTERNATOR 12V.-300 AMPS

Make.....Delco-Remy
Model Number..... 1117860
Prévost Number 562355

ALTERNATOR 24V.-75 AMPS

Make.....Delco-Remy
Model Number..... 19010000
Prévost Number 562326

ALTERNATOR 12V.-130 AMPS

Make.....Delco-Remy
Model Number..... 1117921
Prévost Number 561265

REGULATOR

Make.....Delco-Remy
Model Number..... 1118447
Type.....Transistor
Voltage adjustment.....External screw
Prévost Number 560030

BATTERY EQUALIZER (50 AMPS)

Make.....Vanner
Model.....60-50A
Amperes .....50 amps
Prévost Number 561016

BATTERY EQUALIZER (100 AMPS)

Make.....Vanner
Model.....60-100C
Amperes .....100 amps
Prévost Number 562332

STARTING MOTOR

Make.....Delco-Remy
Model Number..... 1990269
Series..... 50 MT
Type.....400
Rotation (viewing drive end)..... CW
Brush tension .....5 lb. (2,2 kg) Min.
Voltage 24

No-load test
- Volts.....23
- Min. current draw..... 60 amperes
- Max. current draw ..... 90 amperes
- Min. rpm..... 7000 rpm

Prévost Number 510485

STARTING MOTOR SOLENOID

Make.....Delco-Remy
Model Number..... 1115557

Current Draw 80 °F (27 °C)
- Hold-in winding..... 7.35 - 8.2 amps
- Pull-in winding ..... 48 - 54.5 amps

Volts.....24